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ABSTRACT

As a supplement to the principal reports, basic revision guidelines, philosophy, and procedures are discussed in this document relating to the U. S. Naval Academy Self-Paced Physics Course. Following a brief course description, analyses are made of the rationale for revision activities, study guide alteration, and content, objective, format, and remediation evolution. Revision decisions are made on the basis of empirical findings obtained during the Fall 1969 tryout in weekly posttests, final examinations, and students' study guide performances. The "confidence" scores, faculty and student item ratings, student preferences, fragmentary time logs, and options taken by students when assigned to the option condition are also referred to as additional information pertaining to the improvement of learning materials and processes. Included are a compilation of student academic performances, a detailed record of revision actions, comments of subject matter specialists on each revised problem, and major statistical results used in revision. (Related documents are SE 016 065 - SE 016 087 and ED 062 123 - ED 062 125.) (CC)

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Set #2

DOCUMENTATION REPORT

UNITED STATES NAVAL ACADEMY

Self-Paced

PHYSICS

This document is a supplement to the principal reports 5.10, 5.9, and 5.8, developed and produced under the U. S. Office of Education, Bureau of Research Project #8-0446, for the U. S. Naval Academy at Annapolis, Maryland. Contract #N00600-68C-0749.

5.5 REVISION PROCESS DOCUMENTATION

SE016 088

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I COURSE DESCRIPTION

A foreward to put the course in perspective.

A systems approach was applied to the development of a multimedia computer managed course in college physics for the U.S. Naval Academy. This is a brief description of that course.

Goals

Several purposes are served by the program's development and operation. The Academy is provided with a cost-effective physics course designed with the most modern educational technology. The experience garnered in the construction of the program is incorporated into a course development model to serve as a prototype for construction of similar programs in other hard science courses. Extensive record keeping capabilities of the program allow it to serve as a vehicle for educational research.

Characteristics

The course is individualized, self-paced, and self-healing. By offering media options and optional routes through the learning materials each student's learning experience is individualized. Likewise, within broad time constraints, the student can progress through these materials at his own pace.

The self-healing aspect of the program pertains to learning materials and processes. These are improved by an iterative process of successive tryouts and revisions. In this way, the program undergoes an empirical optimization procedure.

Content

Most standard topics in introductory classical physics are included in the two semester course: mechanics, wave phenomena, electricity, magnetism, and optics. One unusual feature is the omission of heat and thermodynamics in favor of more intensive developments in mechanics and optics to suit the Academy's particular needs. The subject matter is loosely defined as university physics with calculus at the level of Halliday and Resnick.

Systems Approach

Optimization of the program must be attained empirically, since no satisfactory predictive theory of educational psychology is known. This situation is well suited to a systems approach when the output of the system can be fed back to modify the system input.

Behavioral Objectives

This approach requires that the course objectives are clearly defined and measurable so that the output of the system is quantitative. Consequently, over a thousand measurable behavioral objectives (MBOs) were developed to completely specify the performance which the program should elicit. MBOs fall into two categories: terminal objectives (TOs) which describe the desired final student behavior, and the subordinate enabling objectives (EOs) which are steps toward the terminal behavior.

The TOs constitute a complete description of course content and are represented in the course by central *core* problems. When a student can answer a core problem correctly, he is said to have achieved that TO. In this way a student knows exactly what is expected of him as to content and level of proficiency.

When a student cannot answer a core problem after a single exposure, he can execute subordinate *enabling* problems which correspond to the EOs. At the end of an enabling sequence, the student is presented with another version of the core problem to check his achievement of the TO. All these problems are contained in the *Problem and Solution Book* volumes.

Media Components

Videotape presentations are available for forty-nine topics. These tapes average about fifteen minutes apiece. Illustrated texts and talking books (taped voice-over illustrations in book form) are available with essentially the same information content as the video tapes. (Computer-assisted instruction (CAI) was initially included as a parallel path for topics in mechanics, primarily to be compared with the other options for cost effectiveness, and was deleted as a learning option in the final revision.) Conventional physics texts are also included among the available learning materials.

Testing

Each student is provided with a *study guide* which directs him through the problem books and various media assignments. When the student completes a specified assignment (roughly approximated by a

chapter in Halliday and Resnick), he schedules a *progress check* (test) on the material. This criterion check does not influence his grade but is used for management and remediation purposes. Grades are determined by quarterly tests and final examinations for each semester.

Remedials

Minor remediation is accomplished by distributing a *remedial sheet* associated with each problem missed on the progress check. These sheets have a statement of the appropriate core problem together with references to pertinent auxiliary material. More serious remediation is provided by individual tutorial sessions with a professor.

Laboratories

The laboratories have as their objectives the measurement of fundamental physical quantities, including the processing and recording of this data with an error analysis. An innovative aspect of the data analysis is that a dialogue may be established between the student and the computer which would culminate in the student's achievement of the objective. This computer-dialogue laboratory format is not an essential element of the multi-media learning materials, and in the current implementation the Navy Physics staff is using a conventional laboratory experience for the self-paced course.

II THE REVISION PROCESS

An overview of the revision effort including general revision guidelines, philosophy, and approach.

The Revision Process

Three basic sets of data present the results of the Physics S211 multimedia course: the weekly posttest scores and item analyses; the final examination scores and item analyses; and the Study Guide problem scores, and breakdown of choices selected. Additional information is provided by the "confidence" scores, faculty and student item ratings, student preferences, the fragmentary time logs (these were kept by students only inconsistently, less accurately than was necessary, and were impossible for faculty or project staff to control), and the options taken by the students when assigned to the Student Option condition. These sets of data provided the inputs for the initial revision decisions. As other analyses are performed (e.g., student characteristics, media materials, experimental treatments), the results will be utilized in further revision procedures.

In simple terms, the purposes for which data are examined are the following: to determine how well the existing course materials facilitated learning, and how reliably they did so; to determine which objectives were major sources of difficulty; to determine where the instructional materials were especially strong or weak; to determine how satisfactorily the basic course structure and design accomplished the "ideal" mission of teaching all objectives to all students. This is only the first step; a revision should be planned on information provided by the data, and not simply be a "now let's try something else" set of changes.

It will be well to structure the description of the findings within a review of certain assumptions within which the tested version of the course was developed. The multimedia course was developed with an "open front end." This means that except for the descriptions of the course objectives that were given to the students at the beginning of each week's work, there was no guidance or control exercised over the students' learning activities; they began by studying assigned portions of conventional text materials. The students (except for certain of the experimental conditions) then worked through a set of relevant problems in the Study Guide, were branched to corrective information when an error was made, and then proceeded to the weekly posttest. Certain supplementary media materials were provided certain students as designated by the experimental design, but that phase need not concern us for the time being. In addition to the remedial branching provided by the Study Guides, a preliminary version of a computer management system was utilized to provide posttest results information to the physics faculty so that students could be assigned to instructor-conducted remedial sessions, individually or in small groups. In addition, students were able to consult with instructors at any time for what is referred to as "extra instruction" at the Naval Academy. It is apparent that the basic philosophy and design of the course emphasize *remedial* rather than *shaping*, or, in another context, a Pressey-type approach, rather than a Skinner-type of methodology of instructional design. This approach represents a minimum kind of instructional programming and guided or controlled interaction, often assumed to be more appropriate and "all that is necessary" at the college and university level.

The results of the evaluation run-through indicate that the multimedia course, at this stage in its developmental testing, did about as well as the existing conventional course in terms of achievement. The positive side of this picture is the fact that the experimental course was a newly developed set of instructional events and materials and performed as well as the conventional course, a course that had been in operation at the Naval Academy for years, was very similar to other existing courses, and which had been revised and improved for many years by many faculty members. The experimental course, even under the various controls, schedules, and constraints of the testing requirements, the experimental design, data collection requirements, and the practical requirements of the Academy itself, produced results equivalent to those produced by the course with a much longer history of development. On the other side of the picture, however, the experimental multimedia course, S211, did not do any better than the existing course, and no time savings were possible on an individual student schedule basis because it was not possible to operate a "free running course" within the constraints and requirements noted above.

The "successive approximations" approach to course development, if appropriately applied, specifies that a "lean" approach be used. This means that successive drafts should undershoot the mark, progressively less with each revision. If students are given more guidance, direction, and too much of a small step approach, there is no convenient way to determine where too much of anything was provided, or where less direction, less control, or less guidance might have been able to accomplish the instructional tasks. The lean approach specifies that less instructional involvement and less control be exercised than is assumed to be needed, so that the empirical validation procedures can identify exactly where the deficiencies are, so that minimum necessary changes can be made. In other words, over-teaching generally cannot be identified if the instruction is successful, but under-teaching, when unsuccessful, can be precisely identified and the necessary revisions made.

The lean approach was used for the development of the tested version of the course being discussed in this report, at several levels, and for a number of components, activities, and materials. Specifically, the following components were lean, and for each a "less lean" form is described. Where the evidence indicates that the present lean version did not accomplish its task, the less lean form will receive first consideration for the revision presently underway.

1. Objectives: lean version is a simple descriptive statement for the student, generally in the same form developed and used by the course designers and faculty; next step would be to simplify the objectives. and provide more detailed explanations at a level comprehensible to the students prior to any contact with the study materials. Lean approach assumes that the students will not understand the description completely when they first encounter it, but will develop comprehension

media, prior to the weekly posttest. This variable involvement, and the unstructured nature of the interaction with the information in the conventional textbooks, is seen to be a major source of difficulty and ineffectiveness of the front portion of the course. This revisions should be made more self-standing by including "information panels" *before* the associated problems and by presenting graduated problems with detailed solutions for each objective.

2. The students were given statements of the objectives at the beginning of each week of the course. These objectives were the same descriptions that were initially developed by the course designers for communication with subject matter experts, Academy faculty, and other project staff. The objectives were *not* designed specifically to communicate the intent of the instruction to the student. When objectives are frequently incomprehensible to the student until *after* he has achieved them, students tend to receive far less information from the objectives than is desirable. The purpose of giving a student the objectives is to provide him with a concrete, identifiable goal, and to give him some basis for self-evaluation of progress toward that goal in terms of his own performance capability. If the objectives do not serve that purpose, a major component of the system is missing; if the students recognize the deficiency, they tend to not bother to read the objectives. A major rewriting of objectives is called for to produce a set of written descriptions that will be comprehensible to the students prior to their contact with the study materials, and usable by the students as a progress evaluation guide.

3. The Study Guides were drastically changed for the Fall 1969 tryout, primarily because subject matter specialists involved in the development of the revised Study Guides felt that a more complex level of problems and problem solving skill requirements was desirable than had been required in the previous version of the Guides. The remedial branches and the choices leading to them, were chosen on the basis of subject matter expertise and best judgments about the kinds of errors that would occur, rather than any empirical determination of actual errors that students might make in a free responding situation. The data indicate that the front end of the course, presumably because of the characteristics of the objectives and textbook study described above, did not, in some cases, adequately prepare the student for the problems presented in the Study Guides. Nor, apparently, did the remedial material in the Study Guides adequately function as remedial instruction for students who most needed it, since students were missing questions on the weekly posttests on the same objectives on which they had been remediated in the Study Guides. The level of complexity of the problems must be reviewed in the light of the Study Guide response data, the questions asked, and judg-

the lean approach used for the objectives and textbook study was adequately followed through in this approach to the problem exercises. A more programmed version of the problem exercises could consist of several alternatives. Demonstration problems could be used to illustrate each principle "in action," and certain active response requirements could be inserted within the demonstration sequence. Students could be walked through a series of problems, increasing in difficulty and complexity. A sequence of hints could be provided, in increasing level of amount of information and direction included, so that a student could obtain assistance to the degree that he needed it. The remedial branching could consist of either of the preceding options, so that a student encountering difficulty in the major problem assigned could follow a track leading through further elaboration and assistance in solving simpler problems involving the same principle or approach to a solution. A number of other options exist, but those just described illustrate the kinds of approaches that might be utilized to increase the amount of guidance, direction, and assistance available during the problem-solving exercises.

4. Media components: here we are referring to those components that presented information on the same objectives in different media forms (videotape, audio tape, instructor, etc.) representing several of the treatments in the basic 7 × 7 experimental design. One major issue that was debated by the project staff regarding the nature and format of the media materials was the option of adding specific response requirements, so that students would have to respond actively during or immediately following the media presentation. There is a possibility that if in fact there are differences in the amount and efficiency of learning among the various media presentations, active response requirements would wash out that difference. For several reasons, not the least of which was the pressure on the media production schedule, it was decided not to include response requirements either during a presentation or immediately upon its completion. A number of options exist for reducing the leanness of the media components; a topic outline and note-taking guide can be provided, or specific questions can be asked, with pauses added to the presentation for responding (or the student could, in the case of the equipment-presented media, be directed to stop the presentation), followed by a posttest which could branch the student to remedial material or back to the presentation; without response requirements during the presentation, a practice exercise could precede the posttest, possibly with branching; and there are other possibilities.

5. Remedial instruction following the weekly posttests: the design specified individual or small group remedial instruction, based on an analysis of each student's posttest answers. The instructor was to attempt to diagnose the nature of each student's

difficulty, and attempt to provide remedial instruction and, if desired, assign additional remedial material. Ideally, every deficiency was to be removed before a student proceeded on to the new material of the following week. Here again the remedial emphasis is apparent, and unless the initial learning resulting from the student activities that preceded a posttest was quite high and effective, the remedial burden on this element of the course would be considerable. By its nature, this form of remedial tends to be information presentation oriented, rather than an interactive tutorial, and without criterion questions for progress evaluation use, the burden on both the remedial instructor and the student might be more than could effectively be handled. The next possibility that might be considered is the development of a programmed remedial module for each objective, or at least for every objective that the data indicate is a "trouble topic," accounting for major student difficulties and errors on the posttests, problems, and final examination. This pool of remedial materials, possibly supplemented by the instructors, poses certain developmental problems, and even more important, certain logical problems: if remedial instructional materials, programmed or "conventional," effectively provide remedial instruction ("remedial" assumes student failure has indentified the need for the remedial instruction), they why shouldn't those materials be moved to the front end of the course to prevent the failure from occurring at all? The entire notion of remedial instruction, and its function, design, and placement, as well as its relation to other components of courses of instruction, deserves more attention in both philosophies and technologies of instruction. Some of the considerations will be relevant to the revision planning and decisions here.

The weekly posttest data and the Study Guide performance data, when related to the instructional objectives upon which the problems and posttest items were based, indicates clearly that the open front end of the course, supplemented by the remedial procedures, did not adequately result in students uniformly achieving the objectives. The Study Guide data further indicate that the level and kinds of problems and related remedial did not adequately develop concept learning, concept utilization, and problem-solving skills. Analysis of the problems from behavioral analysis and subject matter analysis points of view produced the following conclusions regarding the beginning portions of the course, including the textbook and Study Guide activities:

1. Textbook study was apparently of variable effectiveness and efficiency, as indicated by the high error rates on the problems in the Study Guides and weekly posttests. Other information provided by students--including descriptive comments and study time information--suggests that textbook study was largely exploratory, cursory, and many students simply scanned the material, planning to study the texts in greater detail after working through the Study Guide problems and

as they achieve the objective and can, therefore, use the description as a progress evaluation criterion; when they understand the description, they have achieved the objective. The more detailed version assumes that additional assistance and information is needed to allow the descriptive statement to help the student, by providing him with a meaningful guide at the beginning to direct his study, his attending, and so that he can evaluate his progress throughout, and not simply discriminate terminal performance when he has achieved it.

2. Textbook study: lean version assumes, first of all, that the lean version of the objectives will accomplish the task described above, and that, therefore, the student's reading of the text materials will include his own directed active responding, interpretation, application, and progress evaluation. The next step would be the addition of specific response requirements, directing the student's attention to critical information and clarifying it, and guiding the direct application, interpretation, and use of that information. Without replacing the existing text with a completely programmed text, the response specifications could be added in varying degrees through the use of an adjunctive program of one of many possible forms.

3. Study Guides: the lean version chosen was one of many possible options. A more appropriate name for the present versions of the Study Guides would be "Problem Book," since the Study Guides do not actually *guide* the study of the students. Here again, the version used assumed that the objectives/textbook combination does its job, as described above. The problems presented require the application of the principles that make up the objectives, and it should be pointed out that a common definition given by physicists of "knowledge of physics" is "the extent to which the student can solve physics problems." Problems of varying degrees of difficulty were included in the Study Guides, some involving straightforward application of a single principle, some requiring analysis of conditions, discrimination of the principles involved, and one or more steps to the solution. The structure of the Study Guide included diagnostic and remedial branching, although the Guides are not branching programs in the usual sense, since they do not include explanatory material preceding a problem. It is assumed that the student has studied the relevant explanatory material in the assigned textbooks. Again, following the lean approach, no attempt was made to teach problem-solving skills in the Study Guides, assuming that the students would bring enough cognitive skills with them from the textbook study to solve each problem, or, if not, would have any deficiencies adequately remediated by the remedial branches in the Study Guides. One reason why the original project staff made the decision to choose this particular approach and Study Guide format was the assumed "high level of motivation" attributed to the Midshipmen. And, of course,

ments regarding the objectives, and the kinds of problem solving skills and activities required to work each problem. Some of these judgments have already proved to be quite straightforward, since in certain problems more was required than the objective specified, particularly in terms of the principle or principles involved, and often in cases in which the students had had no previous opportunity to work on a problem related to that same objective, but in a clearer, less ambiguous form. The students did not adequately achieve the course objectives from the objectives-textbook-Study Guide combination made available to them. The fact that the experimental students performed as well as the controls does not change that evaluation. The experimental course should, when administered in a free-running manner, permit the students to learn more effectively, primarily because of the extensive individualization of instruction. The problem exercises need to be revised to provide more assistance, more guidance, and more opportunity to solve the problems correctly, and more opportunity to respond correctly to the various steps in the problem-solving sequences. The initial review of the Study Guide response patterns was based on two sets of scores: a computer printout indicated the number of students selecting each of the alternatives for each multiple choice diagnostic test item; the printout also indicated the number of students who chose only one answer (presumably the correct one on the first and only try), the number who chose two answers (presumably one error followed by the correct choice), etc. The latter indicates the *amount* of difficulty the students encountered in solving each specific problem, and the former indicates the *kinds* of difficulties the students encountered (assuming, of course, that the questions had no major deficiencies; for a discussion of the test items, see below). One critical questions to be answered is whether or not a student who does well (comparatively speaking) on an objective on the related problems in the Study Guide does any better on the weekly posttest item for that objective than students who do less well on that objective on the Study Guide problems.

4. The test questions answered by the students as they proceeded through the course can be examined and must be examined individually in relation to each other and to the objectives they are designed to test from several points of view. The assumption must be made that there is probably no such thing as a perfect test item, valid in every way, perfectly reliable, testing the related objective at exactly the proper level of complexity, with minimum ambiguity, and whose structure and content is uncorrelated with intelligence or verbal ability. Having made this assumption, we must then view every test item with suspicion; if a student answers a question correctly, we consider the possibility that the item was too easy, or that the correct answer was given away, or for some reason the student was able to answer the question correctly without having achieved the objective; if a student answers a question incor-

rectly, we consider the possibility that the item was too difficult, too ambiguous, the alternatives were inappropriately similar and without an adequate basis for discrimination within the limits of the objective, or that for some reason students who have achieved the objective can still answer the test item incorrectly. Obviously this approach does not involve the rejection of every test item as either too easy or too difficult, nor is the percentage of students answering the item correctly taken as a measure of difficulty. The point that is being made here is that test items are never above suspicion as being major determinants of the answers chosen or given, whether right or wrong, and independent of achievement or non-achievment of the objective the item was designed to test. For example, if 90% of the students answer a question correctly, on a criterion referenced test, that result does not necessarily mean that the instruction related to that objective is highly effective; it could mean that, but it could also tell us nothing at all about the instruction or about the number of students who achieved the objective--it might mean only that the test item was answerable on some basis other than having achieved the objective. Having more than one test item for each objective does not necessarily solve the problem, although one might have more confidence in interpreting the results if five, or even ten or more test items on the same objective all yield similar levels of performance. Unfortunately, a preliminary examination of test items, arranged in groups testing the same objective, indicates that wide variations occur; for example, in one case, twelve problems in one Study Guide were identified as involving the same, single objective, and several items were answered correctly by less than 30% of the students, while others were answered correctly by more than 60% of the students. There are many possible factors to consider in attempting to determine what those data mean, and what accounted for them. Which items give us the most valid information about the students and about the instruction and instructional materials? Here again, a critical examination of the items, the data, and the objectives must be performed by the project subject matter specialists and instructional technologists. Certain judgments must be arrived at, even though a certain amount of subjectivity is involved, which will not be able to be defended in precise fashion by data. The purpose of this type of analysis is to attempt to decide what the data mean, which test items provide the most relevant and meaningful information, and to make revision decisions concerning both the test items and the instructional materials. It is unlikely that a consistent bias would be present in favor of assuming that the instruction is better than it is in fact, since the entire purpose and opportunity at this point is to increase the course effectiveness and efficiency; any inappropriate judgment of acceptability and adequacy would be self-defeating because it would involve passing up an opportunity to improve the instruction at a point at which improvement would be called for by the alternative interpretation of the data.

5. The remedial instruction provided on an individual basis following the identification of the items missed on each post-test was the last element in the basic instructional sequence. Whatever else it may have accomplished, the assigned remedial did not pick up the pieces and adequately remedy the definiencies in the achievement of the objectives. The review problems in the Study Guide used for review purposes at mid-semester and the final examination results indicate that major gaps remained, not only for occasional objectives, but across almost all objectives.

The lean cut described earlier was apparently just about as lean as the more conventional course upon which it was based. The first, preliminary revision procedures have already been decided upon, and their descriptions, along with the data interpretations that led to them, are described in detail below. These basic decisions appear to be justified by the information and data analyses available to date, and are unlikely to be affected by other inputs, such as the statistical analysis of the media design, or more detailed examination of the data that have already been reviewed.

III STUDY GUIDE ALTERATIONS AND THEIR EMPIRICAL BASES

A description of the various revisions in format pace and content and the findings which led to these revisions.

STUDY GUIDE ALTERATIONS

AND THEIR

EMPIRICAL BASES

Data and experience from the Fall 1969 Multimedia Physics Course indicated that Study Guides needed revisions in format, pace, and content.

Core Problems

At the most fundamental level, it was clear that the verbal statements of terminal objectives were not sufficiently precise. By comparing the posttests and final, we found that different subject matter experts, writing from the same statements of objectives, often produced problems of very disparate levels and complexity (see list C in Performance Categories By Objective).

In order to reduce or remove this undesirable elasticity of the terminal objectives, they were cast into problem form. That is, explicit problems whose solutions represent the accomplishment of the behavioral objectives are substituted for their verbal "equivalents." With these *core problems* as the models, course content, level, and complexity are much more precisely defined. This can be seen in part from the fact that core problems average two for every one verbal objective. In short, the core problems are now taken as the definition of course content.

Time Allocated for Problem Solving

Perhaps the greatest single hinderance to criteria achievement in the Fall 1969 version was an insufficient allocation of time to work problems in the Study Guide. The average Study Guide time for all groups for all weeks is 199 minutes per week or 66 minutes per segment. This figure is remarkably small when one considers that even the subject matter experts and instructors find it takes an hour or more to read and solve twenty-four numerical problems and then review each printed solution. And the physicists' performance on these problems is probably faultless and fast. Compare this with the average student's performance which is approximately 40% in error, with each error leading to a time-consuming remedial frame.

Moreover, we recall a widespread rule of thumb among physics instructors used to ascertain the average time a student will need for problem solving: "solve it yourself and mulitply your time by three." Even if a much more modest factor (say 3/2) were employed, we see that a majority of students spent insufficient time for the amount of material at hand. It is likely that students in the conventional Academy course S211 were handicapped in a like manner, since a course with considerably less content density per week has been instituted to replace S211.

Although the Fall 1969 run may have been self-paced for some superior students, it is clear that most midshipmen either had too little time available, or became too fatigued or bored to devote sufficient time to the Study Guide. In accordance with the "lean approach," the minimum required rate has been revised by a modest factor of 2/3, from three segments per week to two segments per week. Thus, an expenditure of an equal amount of time should produce a more complete accomplishment of the objectives.

Extraneous Remediation

In the original format, an effort was made to include remedial instruction for each incorrect answer selection. The data indicate that these time-consuming specific remedial frames were not more effective than one general remedial frame for all distractors. We attribute this to the difficulty in anticipating just which errors are most probable in physics problems.

A reasonable numerical measure of the efficacy of remediation is obtained from the following ratio:

$$\alpha = \frac{\text{number of double choices}}{\text{total number of double, triple, and quadruple choices}}$$

Wholly effective remediation is indicated when α is equal to its maximum value of unity. Completely ineffective remediation would be indicated by a value of 1/3 which would result from a random selection of one answer out of three.

In the special case of Volume N, the same general remedial frame was repeated for each of the three incorrect answer selections. The results for Volume N are compared with the course average in the table below. The α ratios for specific remediation (course average) and general remediation (Volume N) are .59 and .60, respectively. We see that, on the average, the specific remediation frames were not more effective than one overall remedial frame.

choices	one	two	three	four	
general (Vol N)	50.6%	29.3%	11.7%	8.4%	α = .59
specific (course)	58.3%	24.4%	10.8%	6.5%	α = .60

Statements of Objectives

Objectives were written for the student in a concise form which usually required some prior knowledge of the topic for the objective to be understood. Whenever the specific data indicates a weakness in concept or technique which is not primarily attributable to weakness in course materials, the revision includes an *Information Panel* which describes the objectives in behavioral terms which the student can understand *before* he has studied the subject matter.

Alterations

All the forementioned considerations guided changes in format for the revised Problem Books. These alterations are detailed in the List of Revision Activities. Briefly stated, the most significant changes are as follows:

(i) The original unstructured linear sequence of Study Guide problems was reordered so that the core problems are encountered *before* the enabling problems are presented. This provides the student with the clearest statement of the performance which is required of him and provides an excellent advance organizer. If the student is able to solve the core problem, he is allowed to skip the enabling problem sequence. This forward branching economizes the student's time and avoids his laboring unnecessarily over more problems. Another core problem, closely parallel to the original, is presented at the end of an enabling sequence.

(ii) Information panels precede the original core problems.

(iii) Irrelevant remediation was removed, but the detailed solutions to all problems are maintained.

(iv) More flexibility for individualization was provided by separating the Study Guide into two parts, the Problem Book and a *Guide Book*. This Guide Book comprises responsive answer sheets which present the reading assignments, media assignments and optional selections. By making simple changes in these expendable sheets, various paths may be taken through the learning materials.

IV SPECIFIC REVISION ACTIVITIES

A listing of the specific procedures and data used to implement revisions in content, objectives, format, and remediation.

ADJUSTMENT OF CONTENT COVERAGE: OMISSIONS

Activity

Omit those terminal objectives which are of least importance, and which lie outside the scope of a conventional textbook.

Data Base

Professors' Rankings of TO's

TO assignments in Final Exam

Subordinate TO assignments in Final Exam

Director's Chart of Hierarchical Structure

Contents of conventional texts

ADJUSTMENT OF CONTENT COVERAGE: OPTIONS

Activity

Relegate to optional status those terminal objectives which are of lesser importance, which never occur as subordinate TO's in posttests or final exams, and which lie at the lowest level of the structural hierarchy of subject matter.

Data Base

Professors' Rankings of TO's

TO assignments in Final Exam

Subordinate TO assignments in Final Exam

Director's Chart of Hierarchical Structure

Student comments relating to topical interest

VALIDATION OF ITEMS

Activity

List each question and problem as (1) valid, (2) invalid, or (3) grey area, on the basis of the data listed below.

Data Base

Posttest Scores

Posttest Statistics

Final Exam Scores

Final Exam Statistics

Study Guide Scores

Study Guide Statistics

Professors' Rating of Test Items

Posttest Learning Categories

Final Exam Learning Categories

Study Guide Learning Categories

ADJUSTMENT OF CONTENT COVERAGE

Activity

When the level of achievement designated essential for terminal objectives falls below 80% on any validated items, elevate the corresponding enabling objectives to the status of a terminal objective. Establish new, finer grained EO's to correspond to the new TO's.

Data Base

Professors' Ranking of TO's

TO assignments in Final Exam

Subordinate TO assignments in Final Exam

Director's Chart of Hierarchical Structure

Posttest Scores

Posttest Statistics

Final Exam Scores

Final Exam Statistics

List of Validated Materials

WRITING FOR THE NEW TERMINAL OBJECTIVES

Activity

Choose and create questions corresponding to the new enabling objectives. Write "Hint" pages when applicable, and write detailed solutions to the questions.

Resources

The Briggs Program

The AMP Course

Phase I tests and homework problems

USNA final examinations

Phase II remedial material

REVISIONS FOR INVALID AND GREY AREA ITEMS

Each item is individually examined for misleading or ambiguous items, unfamiliar terms, inappropriate coverage of objectives, and other pedagogical faults. Each revision is separately documented.

STRUCTURAL ALTERATIONS I

Motivation and Optimization of Time

Activity

Collect and list questions and problems which, on a one-to-one basis, most closely correspond to the most comprehensive examination of the TO's. Use this list as the backbone of a problem book, so that a student who can solve these problems need not work on enabling objectives associated with and building up to the corresponding TO. This replaces the need for pretests.

Data Base

Professors' Rating of Test Items

Pretests with TO assignments

Posttests with TO assignments

Final Exam with TO assignments

Study Guide

Time in Study Log

Student Preference Data

Extra Instruction Log

STRUCTURAL ALTERATIONS II

Remove Any Irrelevant Remediation

Activity

Statistical evidence indicates that the remedial frames did not measurably improve students' ability to reach criterion. This is attributed to the difficulty in predicting just which errors are most probable in physics problems. Include only those remedial frames which are demonstrated to be effective.

Data Base

Number of answer selections in past Study Guides

STRUCTURAL ALTERATIONS III

Flexibility for
Individualization

Activity

Create a Guide Book which is separate and distinct from the problem book. By simple page changes in the Guide Book, various paths through the learning materials may be made.

The Guide Book includes reading assignments, media assignments, and option selections.

ANCILLARY MATERIAL FOR REMEDIATION

Activity

Collect and create learning materials for remedial study.

Resources

Semat and Blumenthal, "Collect Physics: A Programmed Aid," Volumes 1 - 4

Joseph and Leahy, "Programmed Physics," Volumes 1 - 5

Ashby and Miller, "Principles of Physics: A Programmed Approach," Volumes 1 - 4

The Briggs Program

The AMP Course

Remedials from Phase II

EDITORIAL FUNCTIONS

Activity	Examine all items for acceptable style and language
Data Base	Style Sheet

WRITING TERMINAL OBJECTIVES AT STUDENT LEVEL

Activity	Rewrite each TO in a form which can be understood by a student *before* he encounters the associated learning material.
Data Base	Studies in verbal learning; concept of advance "organizers."

V PERFORMANCE CATEGORIES BY OBJECTIVES

Summary tables of student performances on posttests and final exams listed by objectives.

Of 126 Terminal Objectives, 60 were evaluated by Final Exam test items: all were tested by weekly posttest items. Twenty were closely related to the "media presentation".

Of the 126 objectives, 11 were achieved by 70% or more of the students indicated by both posttest and final exam items: 29 were achieved by 70% or more as indicated by posttests only, no final exam item being relevant to those objectives: and 23 objectives were questionable, with more than 70% on one of the two indicators, and below on the other. This means that at best--assuming "perfect" test items--63 of the 126 objectives (exactly 50%) were achieved by 70% or more of the students.

Less than 70% of the students, as indicated by both posttest and final exam items, achieved 25 of the objectives, and posttest scores for objectives not tested on the final indicate that 38 other objectives were not achieved. Thus a total of 63 objectives--exactly half--failed to meet the arbitrary criterion of achievement by 70% or more of the students.

List A includes objectives on which less than 70% of the students were correct on posttest and final exam. List B includes objectives on which less than 70% were correct on posttest, for objectives not having been tested on the final exam. List C includes objectives tested on both posttest and final exam, and student scores less than 70% on either posttest or final exam.

Lists D and E are objectives that were apparently learned relatively well. List D includes the objectives on which students scored above 70% on both posttest and final exam. List E lists objectives not tested on the final exam, but with posttest scores above 70%.

LIST A - both below 70% 25

OBJECTIVE		POSTTEST	FINAL	AV
8	2, 7	19	60	
10		52	57	
12		33	47	x
16		30	60	
17		0	44	
18		30	58	
19		25	63	
21		47	27	x
37		51	22	
41		54	65	
48		15	47	
68		66	54	x
71		38	60	
73		58	51	
74		51	38	
82		68	27	
84		68	33	
88		46	45	
92		69	60	x
100		65	43	x
106		57	60	
108		30	46	x
114		40	34	
115		19	32	
116		44	59	
		7		

LIST B NO FINALS POSTTEST BELOW 70% 38

OBJECTIVE	POSTTEST	AV
1	45	
2	51	
3	42	
5	48	
9	29	
23	44	
26	16	x
29	11	
32	61	
33	62	x
42	41	
44	56	
46	40	
47	8	
57	67	
58	51	
59	49	
61	67	x
63	50	
79	62	
95	69	
97	41	x
98	45	
101	45	
102	41	
103	31	
105	60	
109	20	x
112	55	
113	20	
118	67	
119	39	
120	68	
121	49	
122	40	
124	30	
125	45	
126	39	

LIST C ONE ABOVE, ONE BELOW 70% 23

OBJECTIVE	POSTTEST	FINAL	AV
4	55	95	
6	32	71	
7	56	75	
11	53	71	
13	96	*38	x
15	54	72	
22	89	*36	
25	85	*27	x
27	58	81	x
34	77	*35	x
45	60	76	
51	83	*65	
52	95	*57	
60	66	76	
62	72	*48	
72	92	*64	
75	74	*47	
89	74	*63	
91	79	*57	
93	80	*12	
107	69	71	
111	82	*65	x
123	73	*52	

LIST D BOTH ABOVE 70% 11

OBJECTIVE		POSTTEST	FINAL	AV
14	31	94	96	x
20		88	75	x
24		76	72	
30		88	77	
31		94	93	x
38		75	79	
40		88	82	x
49		89	78	
65		75	70	x
85		90	72	
86		85	89	
90		76	80	

LIST E NO FINALS POSTTEST ABOVE 70% 29

OBJECTIVE	POSTTEST	AV
28	89	
35	71	x
36	83	x
39	88	
43	76	
50	96	
53	77	
54	90	
55	92	
56	79	
64	100	x
66	98	
67	80	x
69	79	
70	80	
76	73	
77	75	x
78	81	x
80	80	
81	89	
83	87	x
87	90	
94	76	
96	81	
99	72	
104	86	
110	73	x
117	89	

VI REVISION ACTIONS SUMMARY

Detailed record of the actions taken to improve student performance for each terminal objective. (Includes old and new core problem correspondence.)

As part of the final course revision, posttest performance data from every problem was examined, as well as the items themselves, to recognize areas of student difficulty. On the basis of the performance data and thorough problem review remedial actions were performed.

The full complement of remedial actions in the Study Guide consists of appropriate information panels (IP) written for most terminal objectives; new core level problems (CL) which specify and/or exemplify the TO better than any existing problems where existing problems were inadequate to complete an enabling loop; an expansion of the time devoted to an important objective (TE); and in certain instances the expansion of material devoted to the objectives was critical (TEX); and after careful and thorough review some problems were omitted from the revised segments while others underwent some degree of problem revision (P.R.).

A guide to remedial actions has been compiled, arranged according to volume, and within each volume according to TO so that one may discover the new segment location of a particular TO and learn of all remedial actions pertinent to it.

To use the summary, locate the terminal objective to be considered. The far right column refers to remedial actions pertinent to that TO. Information panels are labled according to the problem number they precede. For example: IP 6 means information panel precedes problems number 6 in the segment. Where core level or enabling level problems have been added their location within the segment is included. For example: CL 5 means problem number 5 in the segment is a new problem of a core level. Problem revision numbers refer to the number of the problem in the old version Study Guide, and, if the problem appeared in a segment whose number differs from the new segment in which it appears, the old segment number is given in parentheses. For instance: PR 5 (31) means that problem 5 from the old Study Guide 31 has been revised for use in the new Problem and Solution book in which it appears.

All references to segments and problems pertain to the revised course with the exception of the problem revision (PR) numbers which must refer to the unrevised version.

ACTION LIST

IP

An Information Panel, pertaining to this terminal objective, is now included.

(number after IP means Q# which follows)

CL

Core Level Problem(s) - with solution(s) - has (have) been added.

EL

Enabling Level Problem(s) - with solution(s) has (have) been added.

PR

Problem Revision, amplifications for problems _____.

(Refer to the Revised Problem Documentation for specific Revisions)

TE

Time Expansion factor judged important.

TEX

Time Expansion factor judged crucial.

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST A

T.O.	LIST	SEG	ACTION
1	B	1	IP 13 / CL 13, 16 / EL 14, 15 / PR 1-8 / TE
2	B	1	Removed as a separate objective due to low prof. rating and lack of relevance to other course objectives.
3	B	1	IP 1 / CL 1, 5 / PR 10, 11 / TE
4	C	1	IP 6 / IP 10 / CL 10, 12 / EL 8, 11 / PR 16, 20, 21 IP* 1(2) / IP* 6(2) / CL* 6(2) / EL* 2(2) / PR* 17, 22-24 / TE * Seg 2
5	B	2	IP 10 / PR 1, 2, 3, 4 / TE
6	C	2	IP* 1 / CL* 5 / PR 5, 7 * Seg 3
7	C	2	IP 10 / IP 14 / CL 10, 13, 16 / PR 13
8	A	2	IP* 1 / CL* 5 / PR 12 / TEX * Seg 3
9	B	2	IP* 1 / IP* 12 / CL* 17 / PR 16, 18 * Seg 3

POSTTEST A

(continued)

T.O.	LIST	SEG	ACTION
10	A	2	IP 17 / CL 21 / EL 18 / TEX
11	C	2	IP 14 / CL 16 / PR 21, 22, 23
12	A	3	IP 12 / CL 17, 20 / TEX. This objective is also supported by *all* the preceding TOs.

KEY: IP = information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST B

T.O.	LIST	SEGMENT	ACTION
13	C	4	IP 1 / CL 1, 32 / TEX / PR 10, 11, 14, 19, 24, 4, 13*(5), 17**(6) * Seg 5 ** Seg 6
15	C	4	IP 6 / TEX
16	A	4	IP 16 / CL 20, 28 / TEX / PR 21, 22
		5	CL 4
17	A	5	IP 5 / CL 9 / TEX / PR 4, 8, 14, 19, 20, 21, 24
18	A	5	IP 1 / CL 4 / TE
		6	IP 1, 2 / CL 7, 13 / PR 5, 6, 7, 10
19	A	6	IP 1, 2, 9 / TEX / PR 12, 13, 14, 16, 18, 20, 21, 22, 23, 24

POST TEST C

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

T.O.	LIST	SEGMENT	ACTION
21	A	7	IP 1, 5, 8, 11 / CL 9, 14 / TE / PR 9, 10
22	C	7	CL 14 / TEX
23	B	7	IP 15, 18 / CL 17 / TE / PR 14, 16, 18, 19
25	C	7	IP 24 / CL 23, 29 / TE / PR 4*(8), 18*(8) * Seg 8
26	B	8	IP 9 / CL 12 / TE / PR 5, 6, 7, 8, 9
27	C	8	IP 5 / CL 8 / TE / PR 11, 12, 15, 16
29	B	9	IP 6 / CL 10 / EL 8 / TE / PR 11, 12, 13, 14, 15

KEY: IP = information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST D

T.O.	LIST	SEGMENT	ACTION
30	D	10	IP 1, 5, 10 / CL 4, 5, 9, 12 PR 3, 5, 19 / TE
31	D	10	IP 13 / CL 15/ PR 17, 20, 21 / TE
32	B	10	PR 14, 15, 16 / TE
		11	IP 11/ PR 13, 14 / TE
33	B	10	PR 23, 24 / TE
		11	IP 5 / CL 6, 9, 10 / TE
34	C	11	IP 1 / CL 4 / PR 4 / TE
37	A	11	IP 15, 18 / CL 17, 18, 22 / PR 24, 17, 18, 16, 15 / TEX
		12	IP 1 / CL 9 / PR 4 / TEX
38	E	12	IP 10 / CL 13, 14 / EL 11, 12 PR 6, 7, 8, 9, 21 / TE

KEY: IP = information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST E

T.O.	LIST	SEGMENT	ACTION
41	A	13	IP 1, 4 / CL 3, 9 / PR 7, 8, 9, 12, 16 (19) / TEX
42	B	13	IP 11 / CL 14 / PR 13, 19, 20, 21, 2(14) / TE
43	E	13	PR 14 / TE
46	B	13	IP 19 / CL 18, 23 / PR 4(14), 6(14), 5(15), 15(15) / TE
47	B	14	IP 6 / CL 9 / PR 10, 11, 23, 24 / TE
48	A	14	IP 1, 14 / CL 5, 13 / PR 12, 13, 14, 15, 16, 18, 19, 21, 2(15), 3(15), 4(15), 8(15), 9(15), 16(15), 17(15), 18(15), 19(15) / TEX

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST F

T.O.	LIST	SEGMENT (NEW)	ACTION
49	D	19	IP 1, 11, 15 / CL 11, 14, 19 / EL 12, 13, 17, 18 PR 1(16), 2(16), 3(16), 4(16), 15(16), 16(16) / TE
50	E	19	PR 8(16), 9(16) / TE
51	C	19	IP 6 / EL 8 / PR 20(16), 10(16) / TE
52	C	23	PR 12(16), 13(16), 14(16), 19(24), 22(34) / TE
53	E	20	IP 9, 13, 18 / CL 13, 17, 18 / EL 14, 15 / PR 4(17), 6(17), 18(17) / TE
		21	IP 1 / CL 4 / EL 2(17), 3(17) / TE
55	E	20	IP 5 / PR 8(17), 20(17), 21(17), 23(17) / TE

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST G

T.O.	LIST	SEGMENT (NEW)	ACTION
56	E	22	TE
60	C	21	IP 5 / CL 5 / TE
61	B	21	IP 10, 14 / CL 14 / PR 18(19) TE
63	B	24	IP 1 / PR 20(19) / TE

KEY: IP = Information Panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST I

T.O.	LIST	SEGMENT (NEW NO:)	ACTION
64	E	22	IP 5 / TE
65	D	22	IP 9 / CL 13 / TE
67	E	23	IP 9 / / PR 9(24), 12(24), 5(25) / TE
68	A	23	IP 21 / CL 25 / PR 21(25), 23(24) / TEX
69	E	23	IP 1, 5 / CL 4, 5, 8 / PR 18(25), 18(24), 19(24), 20 (24), 16(25) / TE
70	E	23	IP 17 / CL 20 / PR 9(25), 10(25) / TE

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST J

T.O.	LIST	SEGMENT (NEW NO.)	ACTION
71	A	24	IP 5 / CL 6, 10 / TEX
72	C	24	IP 11 / TE
73	A	24	IP 15 / PR 7(27) / TEX
75	C	25	IP 1 / CL 5 / EL 4 / 23(26) / TE
76	E	25	IP 14 / CL 13, 14, 18 / EL 17 / TE
78	E	26	IP 1 / TE
79	B	25	IP 6 / EL 7 / PR 22(27, 18(27) / TE
		26	IP 6 / EL 8 / PR 20(27) / TE

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST K

T.O.	LIST	SEGMENT	ACTION
81	E	27	IP 1, 6 / CL 1, 5, 6, 9 / EL 30, 32 / PR 9(28) / TE
82		26	IP 10, 15 / CL 14 / EL 13 / PR 14(28), 15(28) / TE
83	E	27	IP 10 / CL 10, 16, 18 / PR 19(28) / TE
84	A	28	IP 1, 6 / TEX
85	D	28	IP 10 / CL 14 / PR 24(29) / TE
86	D	28	IP 15 / CL 19 / TE

KEY: IP = Information panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST L

T.O.	LIST	SEGMENT (NEW NO.)	ACTION
87	E	29	IP 9 / TE
88	A	29	IP 1 / TEX
89	C	29	IP 5 / CL 8 / TE
90	D	29	IP 15, 21 / CL 21, 24 / PR 21(30), 16(30)/ TE
91	C	30	IP 1, 5, 10 / CL 5, 9, 16 / EL 8 / TE
93	C	30	IP 19 / CL 23, 26 / EL 25 / PR 24(31), 19(32) / TE
94	E	31	IP 1 / TE
95	B	31	IP 7, 11 / CL 10, 14 / EL 13 / TE
96	E	31	IP 15 / PR 15(32) / TE

KEY: IP = Information panel (number after IP = question which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST M

T.O.	LIST	SEGMENT	ACTION
99	E	34	IP 9 / PR 3(33) / TE
100	A	34	IP 1, 16 / CL 16 / PR 5(33), 23(34) / TEX
101	B	34	IP 13 / PR 6(35) / TE
102	B	33	IP 1 / CL 4, 8 / PR 11(33) / TE
		35	PR 13(36) / TE
103	B	33	IP 9 / CL 9, 13 / EL 10, 11 / PR 16, 19 / TE
105	B	33	IP 14 / CL 14 / EL 15, 16 / TE
		34	IP 1, 5 / CL 8 / EL 6, 7 / PR 24(33) / TE
106	A	32	IP 9 PR 15(34), 23(24), 2(34), 9(34), 10(35) / TEX

KEY: IP = Information Panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST N

T.O.	LIST	SEGMENT (New No.)	ACTION
107	C	35	IP 1 / CL 1, 5 / TE
108	A	35	IP 6 / / PR 6(36, 18(36) / TEX
110	E	35	IP 10 / TE
112	B	36	IP 1 / CL 5 / EL 2, 3 / PR 2(37) / TE
113	B	36	IP 6 / CL 15, 16 / EL 11 PR 5(37) / TE
114	A	37	IP 1, 6 / TEX
		38	IP 1 / CL / TEX
115	A	37	IP 10 / TEX
116	A	37	IP 14 / CL 14 / TEX

KEY: IP = Information Panel (number after IP = question number which follows)

CL = Core level problem
EL = Enabling level problem
PR = Problem revision
TE = Time expansion
TEX = Critical time expansion

POSTTEST O

T.O.	LIST	SEGMENT (NEW NO.)	ACTION
118	B	38	IP 6 PR 12(39) / TE
119	B	38	IP 11 / TE
120	B	38	IP 18, 22 / CL 18, 26 / PR 20(39) / TE
121	B	39	IP 1, 15 / PR 3(40), 14(40) / TE
122	B	39	IP 7 PR 13(40) / TE
123	C	39	IP 10 / TE
124	B	40	IP 7, 15 / TE
126	B	40	IP 1, 11 / CL 11, 14 / TE

VOL A SEG 1, 2, 3

SEG 1

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TC
1	New		
6	16	A 2, H 1	4
10	New		
13	New		

VOL A SEG 1, 2, 3

SEG 2

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1	15(1)	A 10	9
6	New		
10	New		
14	22	A 6	11
17	New		

VOL A SEG 1, 2, 3

SEG 3

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1	20	A 9, H 2	6
6	13	A 10	9
12	11	A 9, H 2	6
18	4	A 10	9

VOL B SEG 4, 5, 6

SEG 4

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(4)	25	B 1	13
2(4)	2	B 1	13
5	4	B 1	13
6	8	B 2	14, 15
11	12	B 3	15
16	21	B 5	16
21	14		
26	19		
29	10		
32	26		

VOL B SEG 4, 5, 6

SEG 5

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(5)	1	B 6	17, 14
2	3	B 6	17, 14
5	8		
10	9		
11	20		
12	21		
13	10		
18	11		

VOL B SEG 4, 5, 6

SEG 6

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(6)	9		
2	8	B 7	18
8	11		
9	15		
14	21	B 4	19
15	20		
16	23		

VOL C SEG 7, 8, 9

SEG 7

CORE		POSTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(7)	6		
2	3	C 1	20
5	9	C 2	21
10	24	C 3	22
15	18	C 4	23
18	16	C 4	23
24	21		
27	22		

VOL C SEG 7, 8, 9

SEG 8

CORE		POSTTEST QUESTIONS	TO
NEW NO	OLD NO		
1(8)	2	C 5	24, 25
5	11	C 6 / C 8	25, 27/27
9	7	C 7	26
13	17		
18	22		

VOL C SEG 7, 8, 9

SEG 9

CORE		POSTTEST QUESTIONS	TO
NEW NO	OLD NO		
1(9)	4	C 9	28
4	8	C 9	28
6	14	C 10	29

VOL D SEG 10, 11, 12

SEG 10

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(10)	19	D 1, H 10	30
5	new		
10	5	D 1, H 10	30
13	18	D 2	31
16	12	D 3	32
19	22	D 4, H 11	33

VOL D SEG 10, 11, 12

SEG 11

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(11)	1	D 5	34
5	12(12)	D 4, H 11	33
11	17(12)	D 3	32
15	24	D 8, H 12	37
18	25 new		

VOL D SEG 10, 11, 12

SEG 12

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(12)	21 (11)	D 8, H 12	37
6	18	D 8, H 12	37
10	6	D 9	38
14	5	D 9	38

VOL E SEG 13, 14, 15

SEG 13

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(13)	10	E 3, H 13	41
4	7	E 3, H 13	41
10	14	E 5	43
11	19	E 4	42
15	5(15)	E 8	46
19	8(14)	E 8	46

VOL E SEG 13, 14, 15

SEG 14

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(14)	7(15)	E 10, H 15	48
6	6(15)	E 9	47
10	19(15)	E 10, H 15	48
14	20(14)	E 10, H 15	48

VOL G SEG 18, 19

SEG 19

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(19)	1(16)	F 1, H 16	49
2	2(16)	F 1, H 16	49
5	7(16)	F 3	50
6	21(16)	F 7, F 9	54
11	New		
15	15(16)	F 1, H 16	49

VOL H SEG 20, 21, 22

SEG 20

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(20)	New		
5	7(14)	F 8	55
9	4(17)	F 6, F 10, H 18	53
13	New		
18	New		

VOL I SEG 20, 21, 22

SEG 21

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(21)	14(14)	F 6, F 10, H 18	53
5	New		
10	5(19)	G 7, H 20	62
14	New		

VOL H SEG 20, 21, 22

SEG 22

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(22)	1(18)	G 1	56
4	New		
5	2(23)	I 1	64
9	8(23)	I 2, I 10	65
14	14(23)	I 2, I 10	65

VOL I SEG 23, 24, 25

SEG 23

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(23)	18(25)	I 7	69
5	New		
9	3(24)	I 4, I 5, I 9	67
17	14(25)	I 8	70
21	7(25)	I 6	68
22	19(25)	I 4, I 5, I 9	67
23	21(25)	I 6	68
24	13(25)	F 2, F 5, H 17	52
25	New		

VOL I SEG 23, 24, 25

SEG 24

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(24)	6(19)	G 8	63
6	New		
11	6(26)	J 2	72
15	8(27)	J 3	73

VOL I SEG 23, 24, 25

SEG 25

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(25)	22(26)	J 5	75
6	19(27)	J 9	79
10	20(26)	J 5	75
14	New		

VOL J SEG 26, 27

SEG 26

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(26)	15(27)	J 8	78
6	24(27)	J 9	79
10	12(28)	K 1, K 10, *K 6, *K 9	82
15	13(28)	K 1, K 10, *K 6, *K 9	82

VOL J SEG 26, 27,

SEG 27

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(27)	New		
6	New		
10	New		
16	New		

VOL K SEG 28, 29

SEG 28

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(28)	5(29)	K 9, *K 2	84
6	11(29)	K 9, *K 2	84
10	15(29)	K 9, *K 2	84
15	19(29)	K 4, K 5, *K 7, *K 10	86

VOL K SEG 28, 29

SEG 29

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(29)	9(30)	L 2, *L 1	88
5	13(30)	L 3, *L 9	89
9	3(30)	L 1, *L 10	87
15	22(30)	L 3, *L 9	89
21	New		

VOL L SEG 30, 31, 32

SEG 30

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(30)	3(31)	L 5, *L 8	91
5	New		
10	12(31)	L 5, *L 8	91
16	New		
19	21(31)	L 7	93
23	New		

VOL L SEG 30, 31, 32

SEG 31

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(31)	9(32)	L 8, *L 4	94
7	8(32)	L 9, *L 6	95
11	11(32)	L 9, *L 6	95
15	14(32)	L 10, *L 5	96

VOL L SEG 30, 31, 32

SEG 32

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(32)	5(33)	M 4	100
4	5(34)	M 10	106
9	19(34)	M 10	106
16	New		

VOL M SEG 33, 34, 35

SEG 33

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(33)	11	M 6	102
5	14	M 6	102
9	New		
14	New		

VOL M SEG 33, 34, 35

SEG 34

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(34)	24(33)	M 7	105
5	21(33)	M 7	105
9	9(35)	M 10	106
13	6(35)	M 4	100

VOL M SEG 33, 34, 35

SEG 35

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(35)	New		
6	7(38)	N 3	109
10	23(36)	N 4	110
15	13(36)	M 6	102

VOL N SEG 36, 37, 38

SEG 36

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(36)	2(37)	N 6	112
6	5(37)	N 7	113
10	18(38)		157
15	New		
16	New		

VOL N SEG 36, 37, 38

SEG 37

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(37)	9(37)	N 8	114
6	18	N 8	114
10	13	N 9	115
14	New		

VOL N SEG 36, 37, 38

SEG 38

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(38)	New		
6	12 (39)		158
11	15(39)	0 3	119
18	New		
22	23(39)	0 4	120

VOL O SEG 39, 40, 41

SEG 39

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(39)	21(40)	O 5	121
7	10(40)	O 6	122
10	19(40)	O 7	123
15	14(40)	O 5	121

VOL O SEG 39, 40, 41

SEG 40

CORE		POSTTEST	
NEW NO	OLD NO	QUESTIONS	TO
1(40)	17(41)	O 10	126
7	20(41)	O 8	124
11	New		
15	21(41)	O 8	124

PROBLEM CORRESPONDENCE

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
1	1 (new)		
1	2	1	9
1	3	1	10
1	4	1	12
1	5 (new)		
1	6	1	16
1	7	1	19
1	8 (new)		
1	9 (new)		
1	10 (new)		
1	11 (new)		
1	12 (new)		
1	13 (new)		
1	14 (new)		
1	15 (new)		
1	16 (new)		
2	1	1	15
2	2 (new)		
2	3	1	22
2	4	1	13
2	5 (new)		
2	6 (new)		
2	7	1	14
2	8	1	17
2	9	1	18
3	10 (new)		
2	11	2	6
2	12	2	10
2	13 (new)		
2	14	2	22
2	15	2	7
2	16 (new)		
2	17 (new)		
2	18 (new)		
2	19	2	20
2	20	3	12
2	21 (new)		
3	1	3	20
3	2	2	14
3	3	2	15
3	4	2	16
3	5 (new)		
3	6	3	13
3	7	2	18

PROBLEM CORRESPONDENCE
(continued)

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
3	8 (new)		
3	9	3	11
3	10	2	17
3	11 (new)		
3	12	3	4
3	13	3	5
3	14	3	1
3	15	3	2
3	16	3	3
3	17 (new)		
3	18	3	18
3	19	3	8
3	20 (new)		
4	1 (new)		
4	2	4	2
4	3	4	1
4	4 (new)		
4	5	4	4
4	6	4	8
4	7	4	6
4	8	4	3
4	9	4	5
4	10 (new)		
4	11	4	12
4	12	4	17
4	13	4	7
4	14	4	9
4	15 (new)		
4	16	4	21
4	17	4	20
4	18	4	23
4	19	4	22
4	20 (new)		
4	21	4	14
4	22	4	11
4	23	4	24
4	24	4	13
4	25 (new)		
4	26	4	19
4	27	4	15
4	28 (new)		
4	29	4	10
4	30	4	18
4	31 (new)		
4	32	4	26
5	1	5	1

PROBLEM CORRESPONDENCE
(continued)

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
5	2	5	3
5	3	5	2
5	4 (new)		
5	5	5	8
5	6	5	5
5	7	5	7
5	8	5	14
5	9 (new)		
5	10	5	9
5	11	5	20
5	12	5	21
5	13	5	10
5	14	5	15
5	15	5	16
5	16	5	25
5	17 (new)		
5	18	5	11
5	19	5	12
5	20	5	13
5	21 (new)		
6	1	6	9
6	2	6	8
6	3	6	1
6	4	6	2
6	5	6	4
6	6	6	3
6	7 (new)		
6	8	6	11
6	9	6	15
6	10	6	14
6	11	6	13
6	12	6	16
6	13 (new)		
6	14	6	21
6	15	6	20
6	16	6	23
7	1	7	6
7	2	7	3
7	3	7	1
7	4 (new)		
7	5	7	9
7	6	7	7
7	7	7	4
7	8 (new)		
7	9	7	10
7	10	7	27

PROBLEM CORRESPONDENCE
(continued)

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
7	11	7	11
7	12	7	12
7	13	7	13
7	14 (new)		
7	15	7	18
7	16	7	19
7	17 (new)		
7	18	7	16
7	19	7	7
7	20	7	14
7	21	7	17
7	22	7	20
7	23 (new)		
7	24	7	21
8	1	8	2
8	2	8	1
8	3	8	3
8	4 (new)		
8	5	8	11
8	6	8	10
8	7	8	12
8	8 (new)		
8	9	8	7
8	10	8	5
8	11	8	9
8	12 (new)		
8	13	8	17
8	14	8	14
8	15	8	15
8	16	8	16
8	17 (new)		
8	18	8	22
9	1	9	4
9	2	9	3
9	3 (new)		
9	4	9	8
9	5 (new)		
9	6	9	14
9	7	9	13
9	8 (new)		
9	9	9	11
9	10 (new)		
10	1	10	19
10	2	10	1
10	3	10	7
10	4 (new)		

PROBLEM CORRESPONDENCE
(continued)

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
10	5 (new)		
10	6	10	2
10	7	10	3
10	8	10	4
10	9 (new)		
10	10	10	5
10	11	10	6
10	12 (new)		
10	13	10	18
10	14	10	9
10	15 (new)		
10	16	10	12
10	17	10	11
10	18	10	13
10	19	10	22
10	20	10	23
10	21	10	24
11	1	11	1
11	2	11	5
11	3	11	4
11	4 (new)		
11	5	12	12
11	6	11	7
11	7	11	2
11	8	11	3
11	9	11	6
11	10 (new)		
11	11	12	17
11	12	12	13
11	13	11	11
11	14 (new)		
11	15	11	24
11	16	12	14
11	17 (new)		
11	18 (new)		
11	19	11	17
11	20	11	18
11	21	11	19
11	22 (new)		
12	1	11	21
12	2	11	20
12	3	11	22
12	4	11	23
12	5	12	4
12	6	12	18
12	7	12	2

PROBLEM CORRESPONDENCE
(continued)

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
12	8	12	1
12	9 (new)		
12	10	12	6
12	11 (new)		
12	12 (new)		
12	13 (new)		
12	14	12	5
12	15	12	10
12	16	12	11
12	17 (new)		
13	1	13	10
13	2	13	8
13	3 (new)		
13	4	13	7
13	5	13	17
13	6	13	18
13	7	13	12
13	8	13	9
13	9 (new)		
13	10	13	14
13	11	13	19
13	12	13	21
13	13	14	2
13	14 (new)		
13	15	15	5
13	16	14	3
13	17	14	6
13	18 (new)		
13	19	14	8
13	20	14	7
13	21	13	23
13	22	13	24
13	23 (new)		
14	1	15	7
14	2	15	1
14	3	15	2
14	4	15	3
14	5 (new)		
14	6	15	6
14	7	14	9
14	8	14	22
14	9 (new)		
14	10	15	19
14	11	15	9
14	12	14	16
14	13 (new)		

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
14	14	14	20
14	15	14	18
14	16	15	16
19	1	16	1
19	2	16	2
19	3	16	3
19	4	16	6
19	5	16	7
19	6	16	21
19	7	16	11
19	8 (new)		
19	9	16	22
19	10	16	20
19	11 (new)		
19	12 (new)		
19	13 (new)		
19	14 (new)		
19	15	16	15
19	16	16	5
19	17 (new)		
19	18 (new)		
19	19 (new)		

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
20	1 (new)		
20	2	17	1
20	3	17	2
20	4 (new)		
20	5	17	7
20	6	17	19
20	7	17	9
20	8	17	8
20	9	17	4
20	10	17	3
20	11	17	5
20	12	17	12
20	13 (new)		
20	14 (new)		
20	15 (new)		
20	16	17	13
20	17 (new)		
20	18 (new)		
20	19	17	18
20	20	17	17
21	1	17	14
21	2 (new)		

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
21	3 (new)		
21	4 (new)		
21	5 (new)		
21	6	19	15
21	7	19	2
21	8	19	7
21	9	19	21
21	10	19	5
21	11	19	4
21	12	19	10
21	13	19	18
21	14 (new)		
21	15	19	12
21	16	19	14
21	17	19	19
22	1	18	1
22	2	18	11
22	3	18	12
22	4 (new)		
22	5	23	2
22	6	23	3
22	7	23	1
22	8	23	6
22	9	23	8
22	10	23	4
22	11	23	5
22	12	23	7
22	13 (new)		
22	14	23	14
22	15	23	10
22	16	23	9
22	17	23	11
23	1	25	18
23	2	25	15
23	3	24	13
23	4 (new)		
23	5 (new)		
23	6	24	16
23	7	24	17
23	8 (new)		
23	9	24	3
23	10	24	1
23	11	24	2
23	12	24	4
23	13	24	15
23	14	23	17

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
23	15	24	22
23	16	24	9
23	17	25	14
23	18	24	14
23	19	24	24
23	20 (new)		
23	21	25	7
23	22	25	19
23	23	25	21
23	24	25	13
23	25 (new)		
24	1	19	6
24	2	19	9
24	3	19	8
24	4	19	22
24	5	19	17
24	6 (new)		
24	7	26	1
24	8	26	2
24	9	26	7
24	10 (new)		
24	11	26	6
24	12	26	3
24	13	26	9
24	14	26	10
24	15	27	8
24	16	26	11
24	17	26	12
24	18	26	21
24	19	27	5
24	20	27	6
25	1	26	22
25	2	26	16
25	3	26	5
25	4 (new)		
25	5 (new)		
25	6	27	19
25	7 (new)		
25	8	26	19
25	9	27	23
25	10	26	20
25	11	26	13
25	12	26	17
25	13 (new)		

PROBLEM CORRESPONDENCE
(continued)

NEW SEG #	NEW PROB #	OLD SEG #	OLD PROB #
25	14 (new)		
25	15	27	1
25	16	27	2
25	17 (new)		
25	18 (new)		
26	1	27	15
26	2	27	10
26	3	27	11
26	4	27	12
26	5	27	16
26	6	27	24
26	7	27	21
26	8 (new)		
26	9	27	20
26	10	28	12
26	11	28	1
26	12	28	3
26	13 (new)		
26	14 (new)		
26	15	28	13
26	16	28	2
26	17	28	4
26	18	28	5
26	19	28	14
26	20	28	15
26	21	29	20
26	22	27	17
27	1 (new)		
27	2	28	7
27	3	28	8
27	4	28	9
27	5 (new)		
27	6 (new)		
27	7 (new)		
27	8 (new)		
27	9 (new)		
27	10 (new)		
27	11	28	21
27	12	28	20
27	13	28	24
27	14	29	22
27	15	28	23
27	16 (new)		
27	17	28	18
27	18 (new)		
28	1	29	5

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD		NEW		OLD	
SEG #	PROB #	SEG #	PROB #	SEG #	PROB #	SEG #	PROB #
28	2	29	1	29	6	30	12
28	3	29	2	29	7	30	14
28	4	29	4	29	8 (new)	30	
28	5	29	6	29	9	30	3
28	6	29	11	29	10	30	1
28	7	29	8	29	11	30	4
28	8	29	9	29	12	30	5
28	9	29	10	29	13	30	15
28	10	29	15	29	14	30	6
28	11	29	13	29	15	30	22
28	12	29	14	29	16	30	17
28	13	29	17	29	17	30	18
28	14 (new)			29	18	30	20
28	15	29	19	29	19	30	19
28	16	29	16	29	20	30	21
28	17	29	28	29	21 (new)		
28	18	29	18	29	22	30	23
28	19 (new)			29	23	30	24
29	1	30	1	29	24 (new)		
29	2	30	7	30	1	31	3
29	3	30	8	30	2	31	2
29	4	30	11	30	3	31	1
29	5	30	13	30	4	31	4

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
30	5 (new)		
30	6	31	5
30	7	31	8
30	8 (new)		
30	9 (new)		
30	10	31	12
30	11	31	6
30	12	31	7
30	13	31	9
30	14	31	11
30	15	31	13
30	16 (new)		
30	17	31	10
30	18	31	14
30	19	31	21
30	20	31	15
30	21	31	17
30	22	31	22
30	23 (new)		
30	24	31	18
30	25 (new)		
30	26 (new)		

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
31	1	32	9
31	2	32	1
31	3	32	5
31	4	32	2
31	5	32	3
31	6	32	4
31	7	32	8
31	8	32	6
31	9	32	7
31	10 (new)		
31	11	32	11
31	12	32	10
31	13 (new)		
31	14 (new)		
31	15	32	14
31	16	32	15
31	17	32	12
31	18	32	13
32	1	33	5
32	2	34	1
32	3	33	4
32	4	34	5

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD		NEW		OLD	
SEG #	PROB #	SEG #	PROB #	SEG #	PROB #	SEG #	PROB #
32	5	34	6	33	6	33	13
32	6	34	4	33	7	33	15
32	7	34	3	33	8 (new)		
32	8	34	8	33	9 (new)		
32	9	34	19	33	10 (new)		
32	10	34	14	33	11 (new)		
32	11	34	15	33	12	33	16
32	12	34	17	33	13 (new)		
32	13	34	11	33	14 (new)		
32	14	34	12	33	15 (new)		
32	15	34	18	33	16 (new)		
32	16 (new)			33	17	33	19
32	17	34	24	34	1	33	24
32	18	34	20	34	2	33	20
32	19	34	21	34	3	33	22
32	20	33	6	34	4	33	23
32	21	33	7	34	5	33	21
32	22	34	23	34	6 (new)		
33	1	33	11	34	7 (new)		
33	2	33	10	34	8 (new)		
33	3	33	9	34	9	35	9
33	4 (new)			34	10	33	1
33	5	33	14	34	11	33	2

PROBLEM CORRESPONDENCE
(continued)

NEW		OLD	
SEG #	PROB #	SEG #	PROB #
34	12	33	3
34	13	35	6
34	14	35	1
34	15	35	22
34	16	35	3
34	17	35	4
34	18	35	5
34	19	35	7

VII REVISED PROBLEM DOCUMENTATION

Comments of subject matter experts pertaining to each revised problem.

Segment 1 #1-8

These items lack relevance to the understanding of physics and have been omitted.

T.O. 1

Segment 1 #10

R1	R2	R3	R4
27	72	25	7

A valid item which has been retained in the study guide. Performance data is attributed primarily to other factors as indicated.

T.O. 3

Segment 1 #11

R1	R2	R3	R4
25	84	16	6

Although the item and its pertinent data are valid, it has been omitted since other questions better support the T.O.

T.O. 3

Segment 1 #16

R1	R2	R3	R4
59	57	12	0

A valid question which has been retained in the study g ide.

T.O. 4

Segment 1 #17

R1	R2	R3	R4
52	48	20	9

A valid item which remains in the study guide.

T.O. 4

Segment 1 #20

R1	R2	R3	R4
104	9	0	1

Although this item is valid other questions support the T.O. and are preferred.

T.O. 4

Segment 1 #21

R1	R2	R3	R4
67	24	13	10

Although this item is valid other questions support the T.O. and are preferred.

T.O. 4

Segment 1 #22

R1	R2	R3	R4
46	35	22	11

With minor modification of the correct answer this item has been retained.

T.O. 4

Segment 1 #23

R1	R2	R3	R4
38	22	25	27

A valid item, however its contents are best handled in the information panel.

T.O. 4

Segment 1 #24

R1	R2	R3	R4
77	26	10	3

This item has been rejected since it requires an ability not relevant to this level course.

T.O. 4

Segment 2 #1

R1	R2	R3	R3
99	30	4	0

This item has been eliminated from the study guide since its content is not relevant to the course objectives.

T.O. 5

Segment 2 #2

R1	R2	R3	R4
102	26	4	0

This item has been omitted for content deficiencies.

T.O. 5

Segment 2 #3

R1	R2	R3	R4
122	9	1	0

Item has been rejected for content not pertinent to course objectives.

T.O. 5

Segment 2 #4

RI	R2	R3	R4
109	18	3	0

Other questions, more pertinent to the T.O. have received preference over this item.

T.O. 5

Segment 2 #5

R1	R2	R3	R4
105	22	5	1

This item has been omitted due to content irrelevant to course objectives.

T.O. 6

Segment 2 #7

R1	R2	R3	R4
53	76	3	0

An acceptable question which has been used in the new version study guide.

T.O. 6

Segment 2 #12

R1	R2	R3	R4
57	50	14	8

A valid item, however the question does not adequately test the T.O.

T.O. 8

Segment 2 #13

R1	R2	R3	R4
58	59	10	3

With a slight modification of graph (1) for clarification this problem will be used again.

T.O. 7

Segment 2 #16

R1	R2	R3	R4
51	55	17	4

A valid question which will reappear in the study guide.

T.O. 9

Segment 2 #18

R1	R2	R3	R4
30	41	37	16

An appropriate question to test the T.O. Performance data is attributed primarily to other factors as indicated.

T.O. 9

Segment 2 #21

R1	R2	R3	R4
51	36	23	9

Being merely an exercise in calculus this item will not reappear in the new study guide.

T.O. 11

Segment 2 #22

R1	R2	R3	R4
41	45	18	13

A highly modified version of this question with appropriate changes in the solution will be used as a core question in the new version.

T.O. 11

Segment 2 #23

R1	R2	R3	R4
44	46	15	12

A valid item which will appear in the enrichment segment of the new version study guide.

T.O. 11

Segment 4 #4

R1	R2	R3	R4
43	78	8	0

This item is valid. Its solution may be enhanced by changing the sentence which reads; "A force of 85 lb. . ., " to now read: "A force (the weight) of 85 lb acts downward." Further, since the mathematical solution is quite clear and succinct it too should be included i.e.,

$$\Sigma Fy = 0$$

$$f + (-w) = 0$$

TO 13

Segment 4 #10

R1	R2	R3	R4
37	39	23	30

This item is fully acceptable as it reads. However, commuting it with item eleven (I1) will place both in a more suitable sequence.

TO 13

Segment 4 #11

R1	R2	R3	R4
65	50	12	2

See remarks for item #10 of Segment 4.

TO 13

Segment 4 #13

R1	R2	R3	R4
53	26	34	15

The statement of the problem and its alternate answer are acceptable.

It would be helpful to the student if he could see the vertical component of the external force F, in the solution diagram. Also, usage of the letter "N" for both the normal force and the direction vertically up is ambiguous.

TO 14

Segment 4 #14

R1	R2	R3	R4
54	47	21	6

The problem is valid and well described.

Two trivial changes to "clean-up" the solution may be made. Tha is, replace θ with its equivalent of 30°; and eliminate the words ". . .makes life easier and. . ."

TO 13

Segment 4 #19

R1	R2	R3	R4
37	51	35	3

This is a satisfactory item as it stands. It would, however, be in a better sequence if it was preceded by the supplementary note on tension and by problem #11, and then followed by problem #18.

TO 13

Segment 4 #21

R1	R2	R3	R4
53	58	15	0

This item is valid, however the statement of the problem is incomplete; i.e., it relies heavily on the diagram, and in doing so it may become ambiguous.

Alternate answer C may be considered invalid.

It is recommended that the statement of the problem be rephrased and alternate answer C be replaced.

TO 16

Segment 4 #22

R1	R2	R3	R4
62	50	11	2

Alternate choice "C" of this item is confusing and ambiguous. The item becomes wholly satisfactory when choice "C" is replated by "none of the above".

TO 16

Segment 4 #24

R1	R2	R3	R4
63	6	0	3

This item is a mathematical exercise which should be placed elsewhere in the course.

TO 13

Segment 5 #3

R1	R2	R3	R4
3[illegible]	37	33	12

Additional phrasing, and some rephrasing, of both this problem and its solution, have been done to help in the student's understanding and avoid possible misinterpretations.

TO 14

Segment 5 #4

R1	R2	R3	R4
48	36	26	9

This item has been omitted. Other existing problems give better TO support.

TO 17

Segment 5 #8

R1	R2	R3	R4
58	38	20	2

A few small changes have been made in this problem so that it now reads "cleaner" and uses numbers which work "cleaner".

TO 17

Segment 5 #9

R1	R2	R3	R4
60	37	16	4

The original problem was essentially good. The solution has undergone partial rephrasing primarily to read better.

TO 14

Segment 5 #10

R1	R2	R3	R4
58	36	13	7

While this item remains unchanged, several phrases have been added for its clarification.

In the new segment this item will be followed by the enabling problems 15, 16 and 25.

TO 14

Segment 5 #11

R1	R2	R3	R4
80	24	6	2

This item has undergone what at first seems to be extensive revision. Actually, it remains very much the same problem, but extraneous information has been eliminated.

The explanation has been improved by the addition of an explanatory note and an intermediate algebraic step.

TO 14

Segment 5 #13

R1	R2	R3	R4
95	13	1	1

The old version of this item was unnecessarily wordy. The item has been rephrased to read smoother, and to incorporate the revision of item 11, for which it now serves as an enabling problem.

TO 13

Segment 5 #14

R1	R2	R3	R4
87	4	12	6

A valid item which has been improved by rephrasing, to eliminate redundant information, so that it now reads more easily.

Its solution has been modified to be independent of the solution to problem 8 for which it has become an enabling problem.

TO 17

Segment 5 #15

R1	R2	R3	R4
65	30	14	0

A valid question which essentially required no change for the new study guide.

TO 14

Segment 5 #16

R1	R2	R3	R4
51	40	15	3

In this item, force units were changed to agree with convention, and considerable rephrasing of the correct explanation has been done to aid the student's understanding of this type problem.

TO 14

Segment 5 #17

R1	R2	R3	R4
25	37	39	8

This problem is too trivial to be saved for the new study guides. Better problems are used to support the TO.

TO 14

Segment 5 #18

R1	R2	R3	R4
88	19	0	2

Item has been omitted. Other problems better support the TO.

TO 14

Segment 5 #19

R1	R2	R3	R4
60	36	8	1

Item has been eliminated for its redundancy. Other problems support the TO.

TO 17

Segment 5 #20

R1	R2	R3	R4
44	42	16	2

Original question could be answered intuitively and thus did not test required skill. Therefore, it was changed to require a numerical response. Its position, too, was improved by placing it earlier in the segment, since it is supported by old problems 7 and 14.

TO 17

Segment 5 #21

R1	R2	R3	R4
49	43	7	0

In this item several alternate choices could be considered redundant. The question, and, of course the solution, were modified into a true-false format, and repositioned in the segment.

TO 17

Segment 5 #22

R1	R2	R3	R4
42	25	20	10

This problem has been omitted since its TO is supported by other problems.

TO 14

Segment 5 #23

R1	R2	R3	R4
35	36	20	4

Although this is a valid question it has been omitted. Its TO is supported by other questions.

TO 14

Segment 5 #24

R1	R2	R3	R4
39	27	17	10

The nature and content of this question required placing it for enrichment.

TO 17

Segment 6 #5

R1	R2	R3	R4
57	19	10	3

This item has been omitted due to its lack of support for the TO.

TO 18

Segment 6 #6

R1	R2	R3	R4
49	35	5	0

This item has been omitted due to its lack of support for the T.O.

TO 18

Segment 6 #7

R1	R2	R3	R4
56	14	7	6

This item has been omitted due to its lack of support for the T.O.

TO 18

Segment 6 #10

R1	R2	R3	R4
56	20	2	0

This item has been discarded. It does not support the TO.

TO 18

Segment 6 #12

R1	R2	R3	R4
58	13	1	1

This item has been omitted due to its lack of support for the TO.

TO 19

Segment 6 #13

R1	R2	R3	R4
6	38	23	4

As originally worded, the statement of the problem is confusing and may sustain incorrect concepts.

To overcome these difficulties, the item has been restated in an explicit manner, with an appropriate set of answers.

TO 19

Segment 6 #14

R1	R2	R3	R4
53	8	6	2

Item 14 contains concepts and information needed in the solution of item 13. Therefore, their order has been interchanged.

TO 19

Segment 6 #16

R1	R2	R3	R4
38	22	3	1

Except for a few additional clarifying phases, this item remains valid and otherwise unchanged.

TO 19

Segment 6 #17

R1	R2	R3	R4
29	22	10	2

This item has been removed since it is a problem in Newton's third law of motion and is out of place in this segment.

TO 13

Segment 6 #18

R1	R2	R3	R4
5	16	27	15

Wording of the item is confusing. It has been removed and replaced by a new item.

TO 19

Segment 6 #20

R1	R2	R3	R4
12	21	21	5

This item is valid and has been retained. However, since problem 21 contains concepts useful in the solution of this item, their sequence has been interchanged.

TO 19

Segment 6 #21

R1	R2	R3	R4
17	18	13	11

A valid item but its original question was vaguely worded. The question has been improved and, since it contains concepts useful to the solution of item 20, their order has been interchanged.

TO 19

Segment 6 #22

R1	R2	R3	R4
15	31	11	2

This question has been removed from segment 6 but retained for enrichment.

TO 19

Segment 6 #23

R1	R2	R3	R4
25	19	10	5

Question is valid and, with a small insertion for clarification, has been retained for the new segment.

TO 19

Segment 6 #24

R1	R2	R3	R4
16	14	20	8

Problem 24 is too similar to 16 and therefore is omitted for its redundancy.

TO 19

Segment 7 #7

R1	R2	R3	R4
32	58	22	8

To eliminate possible confusion over quantity of mass, the question has been rephrased using the symbol "m". Wording of the solution also has been improved.

TO 20

Segment 7 #8

R1	R2	R3	R4
36	32	26	27

Entire rephrasing of this problem has been done in a manner which now suggests the sequence of steps for its solution.

TO 20

Segment 7 #9

R1	R2	R3	R4
35	37	33	16

A valid question, but one which may have been misinterpreted by the reader. The question has been entirely restated for the new segment and appropriate changes made in the solution.

TO 21

Segment 7 #10

R1	R2	R3	R4
43	36	26	14

A valid question which, with just a slight change of wording, remains for the new segment.

TO 21

Segment 7 # 14

R1	R2	R3	R4
33	29	30	21

Question is entirely satisfactory as originally stated. It has been retained without change. Performance data is attributed primarily to other factors as indicated.

TO 23

Segment 7 #16

R1	R2	R3	R4
42	22	16	7

The statement of this question now specifies the direction to take for the proper solution. The answer has been entirely re-written to incorporate the preferred solution.

TO 23

Segment7 #18

R1	R2	R3	R4
16	26	12	8

Question has been rephased to be more closely alligned with its TO. Its solution also has been extensively rephrased and clarified.

TO 23

Segment 7 #19

R1	R2	R3	R4
25	25	7	0

The only significant change made in this valid question is from a multiple choice to completion type.

TO 23

Segment 8 #4

R1	R2	R3	R4
49	30	13	6

This item has been omitted for being an invalid question on the stated TO.

TO 25

Segment 8 #5

R1	R2	R3	R4
25	32	29	10

This item has been retained for the new study guide. An information panel will clarify relations between force and potential needed for the solution of this item.

TO 26

Segment 8 #6

R1	R2	R3	R4
38	38	12	4

Item has been eliminated from the new segment.

TO 26

Segment 8 #7

R1	R2	R3	R4
33	41	13	1

This problem with slight modifications, i.e., a more explicitly stated force and completion format, has been retained for the new segment.

TO 26

Segment 8 #8

R1	R2	R3	R4
39	34	15	1

An invalid question which does not support the TO. It is omitted from the new study guide.

TO 26

Segment 8 #9

R1	R2	R3	R4
36	41	13	1

A valid item which has been made more relevant by respecifying the force acting in terms of "g".

TO 26

Segment 8 #11

R1	R2	R3	R4
45	24	9	9

A classic problem, it remains unchanged for the new study guide.

TO 27

Segment 8 #12

R1	R2	R3	R4
35	35	14	0

With a minor change in the drawing to avoid possible confusion and conversion to a completion problem, this item is retained for the new study guide.

TO 27

Segment 8 #15

R1	R2	R3	R4
35	15	15	19

This item is now a completion type and has been extensively rephrased for clarification.

TO 27

Segment 8 #16

R1	R2	R3	R4
29	9	4	5

Item is entirely satisfactory and remains unchanged for the new study guide.

TO 27

Segment 8 #18

R1	R2	R3	R4
10	3	2	2

Item lacks relevance to the TO and therefore has been omitted.

TO 25

Segment 9 #1

R1	R2	R3	R4
59	16	2	0

This item has been omitted since it contains an invalid premise in the "Correct" choice.

TO 28

Segment 9 #8

R1	R2	R3	R4
46	22	2	3

This is a valid and entirely satisfactory item which has been retained for the new segment.

TO 28

Segment 9 #9

R1	R2	R3	R4
36	28	5	0

This question is one of pure mathematics, and not supportive of the TO. Therefore, it has been eliminated.

TO 28

Segment 9 #10

R1	R2	R3	R4
39	14	9	5

This question is beyond the level to the study guide and has therefore been omitted.

TO 28

Segment 9 #11

R1	R2	R3	R4
38	23	5	1

In the drawing pertaining to this problem a massless rod connected two masses together. The rod was removed from the drawing to avoid possible confusion.

TO 29

Segment 9 #12

R1	R2	R3	R4
30	25	6	1

Modification of problem 11 of this segment would make this one a redundant item. Therefore, it has been removed.

TO 29

Segment 9 # 13

R1	R2	R3	R4
34	20	4	2

If the student assumed the plane to be stationary, then alternate answer "C" would also be correct. This possible assumption is eliminated by the insertion of the word "moving" into the statement of the problem.

TO 29

Segment 9 #14

R1	R2	R3	R4
12	24	9	14

This question involves two masses, one of which moves with a motion which is poorly specified. The question has been rephrased to eliminate this confusion.

TO 29

Segment 9 #15

R1	R2	R3	R4
17	13	13	14

This item has been eliminated since it is not relevant to the study guide.

TO 29

Segment 9 #16-24 Insufficient Data

These questions are review questions and consequently there is insufficient data for their validation. All of these items are omitted from the new study guide.

Segment 10 #3

R1	R2	R3	R4
66	36	15	6

The mathematics for the solution of this problem is too difficult for the physics involved. This problem has been changed entirely to make its solution more appropriate.

TO 30

Segment 10 #5

R1	R2	R3	R4
56	21	28	9

Question remains unchanged except now it is a completion question.

TO 30

Segment 10 #14

R1	R2	R3	R4
34	20	9	7

Another question of mathematical acuity. Eliminated from the new study guide.

TO 32

Segment 10 #15

R1	R2	R3	R4
26	43	23	27

This item was eliminated for a multitude of reasons. It is not self-contained (i.e. refers to a drawing in a textbook); it is not a good physics problem; and it does not support the T.O.

TO 32

Segment 10 #16

R1	R2	R3	R4
42	34	22	12

Same comments from item 15 apply.

TO 32

Segment 10 #17

R1	R2	R3	R4
76	16	13	2

Since the solution of this question is based upon a physics principle outside the scope of this course, it has been removed from the study guide.

TO 31

Segment 10 #19

R1	R2	R3	R4
34	38	14	20

This item has been changed to the completion format and moved to the beginning of the segment. Otherwise its content remains unchanged.

TO 30

Segment 10 #20

R1	R2	R3	R4
38	48	10	9

This question has been omitted since the T.O. it supports has been omitted.

TO 31

Segment 10 #21

R1	R2	R3	R4
18	29	17	7

Revision of this item to improve it has made the question redundant. Therefore it has been omitted from the new study guide.

TO 31

R1	R2	R3	R4
33	21	21	28

Segment 10 #23

This question has been eliminated in favor of better questions which support its T.O.

TO 33

Segment 10 #24

R1	R2	R3	R4
57	39	4	2

This item has also been eliminated in favor of better questions which support the T.O.

TO 33

Segment 11 #1

R1	R2	R3	R4
60	39	10	5

A valid, satisfactory question which has been retained unchanged for the new study guide.

TO 34

Segment 11 #4

R1	R2	R3	R4
35	65	7	7

With a trivial label change in the diagram and change in format to completion type, this question remains.

TO 35

Segment 11 #6

R1	R2	R3	R4
47	14	9	10

In the old study guide item 6 depends on the data from item 5. In the new study guide, items 5 and 6 are widely separated. Therefore data from 5 has been re-written and included in 6.

TO 34

Segment 11 #7

R1	R2	R3	R4
60	36	10	7

The statement of this question has been entirely rephrased to eliminate possible confusion with it.

TO 33

Segment 11 #8

R1	R2	R3	R4
33	22	12	4

This question is about kinematics and is not pertinent to the T.O. Therefore it has been removed.

TO 6

Segment 11 #9

R1	R2	R3	R4
43	6	6	4

This question is about kinematics and is not pertinent to the T.O. Therefore it has been removed.

TO 34

Segment 11 #10

R1	R2	R3	R4
32	16	8	2

This question is about kinematics and is not pertinent to the T.O. Therefore it has been removed.

TO 31

Segment 11 #11

R1	R2	R3	R4
26	15	14	18

The question has been extensively rewritten to eliminate irrelevant information and avoid any possible earlier confusion with it.

TO 31

Segment 11 #12

R1	R2	R3	R4
75	27	11	1

This question on Newton's third law is out of place in this segment. It has been omitted from the new study guide.

TO 36

Segment 11 #13

R1	R2	R3	R4
61	44	4	4

Since the correct answer to this multiple choice problem is "none of the above" the student learns nothing new from having worked on this question. Therefore the question does not remain.

TO 36

Segment 11 #14

R1	R2	R3	R4
61	21	19	11

The question is too trivial to do justice to so important a topic (as conservation of momentum certainly is) that it has been removed in favor of better questions.

TO 36

Segment 11 #15

R1	R2	R3	R4
40	44	14	14

This question also has been omitted since it is confusing and serves no purpose in the study guide.

TO 37

Segment 11 #16

R1	R2	R3	R4
78	20	5	3

Since the information obtained from this problem is not an objective of the course the problem has been omitted.

TO 37

Segment 11 #17

R1	R2	R3	R4
72	31	2	0

Question has been reworded for clarification.

TO 37

Segment 11 #18

R1	R2	R3	R4
55	32	11	5

Several clarifying phrases have been added to this problem to avoid misinterpretations by the students.

TO 37

Segment 11 #19

R1	R2	R3	R4
34	45	21	3

Question is satisfactory in original form and will be used without change.

TO 37

Segment 11 #20

R1	R2	R3	R4
46	37	16	2

This item has been used as an enabling question for the new segment 12. Other questions adequately support this T.O.

TO 37

Segment 11 #22

R1	R2	R3	R4
28	7	6	1

This item has been used for an enabling question in the new segment 12. Other questions adequately support this T.O.

TO 37

Segment 11 #23

R1	R2	R3	R4
18	16	5	3

This item has been used for an enabling question in the new segment 12. Other questions adequately support this T.O.

TO 37

Segment 11 #24

R1	R2	R3	R4
33	5	4	0

With extensive rephrasing of the solution, this item remains in the new study guide.

TO 37

Segment 12 #4

R1	R2	R3	R4
18	8	6	16

Except to clarify that the solution has been done in terms of conservation of momentum, and to be a completion question, this problem remains otherwise unchanged.

TO 37

Segment 12 #6

R1	R2	R3	R4
46	30	14	8

Changing this question to a completion type is entirely satisfactory for the new study guide.

TO 38

Segment 12 #7

R1	R2	R3	R4
27	31	18	16

Removed from study guide and placed as an enrichment question.

TO 38

Segment 12 #8

R1	R2	R3	R4
27	10	4	1

This item also has been removed from the study guide and held for enrichment.

TO 38

Segment 12 #9

R1	R2	R3	R4
21	14	1	2

This item has been removed from the study guide and placed as an enrichment question.

TO 38

Segment 12 #12 - 16

These questions on impulse-momentum theorem are misplaced being in this segment. They have therefore been omitted.

#12 = TO 33

#13 = TO 31

#14 = TO 36

#15 = TO 36

#16 = TO 33

Segment 12 #17

R1	R2	R3	R4
15	13	1	1

This item has been removed in favor of others which better substantiate the T.O.

TO 32

Segment 12 #18

R1	R2	R3	R4
23	6	2	4

This item is entirely satisfactory in its original form and remains unchanged (except one typographical error).

TO 37

Segment 12 #19

R1	R2	R3	R4
11	10	8	0

This item, without change, has been placed in the enrichment section.

TO 37

Segment 12 #20

R1	R2	R3	R4
14	6	1	1

This question does not substantiate the T.O. for this segment and thus has been eliminated.

TO 37

Segment 12 #21

R1	R2	R3	R4
10	8	2	0

This question was not used since other questions were preferred for the T.O.

TO 38

Segment 12 #22 - 24

	R1	R2	R3	R4
#22	3	3	0	0
#23	3	3	0	0
#24	4	1	1	0

These items were invalidated for lack of support of basic concept of T.O.

#22 T.O. 153
#23 T.O. 153
#24 T.O. 153

Segment 13 #1

R1	R2	R3	R4
83	20	7	6

Performance data is satisfactory, however the content is sufficiently covered in the new information panel.

T.O. 39

Segment 13 #2

R1	R2	R3	R4
106	7	3	0

Information contained in this item will be covered elsewhere in the new study guide.

T.O. 39

Segment 13 #3

R1	R2	R3	R4
81	29	4	3

Information content of this problem will be covered in the information panel.

T.O. 39

Segment 13 #4

R1	R2	R3	R4
45	40	18	13

This item has been omitted since the T.O. is better supported in another problem.

T.O. 40

Segment 13 #5

R1	R2	R3	R4
90	16	6	4

This item has been omitted since its T.O. is of very low priority.

T.O. 40

Segment 13 #6

RI	R2	R3	R4
38	27	19	32

This question has been omitted since it is confusing and the "correct" answer is partially incorrect and therefore argumentative.

T.O. 40

Segment 13 #7

RI	R2	R3	R4
49	26	10	5

This question has been improved primarily through *extensive* added phrasing to make the solution significantly more informative.

T.O. 41

Segment 13 #8

RI	R2	R3	R4
82	18	22	7

Except for changing units to agreed convention this problem remains essentially unchanged.

T.O. 40

Segment 13 #9

R1	R2	R3	R4
57	29	22	7

The problem was rephrased to be self-contained for the new segment.

T.O. 41

Segment 13 #11

R1	R2	R3	R4
43	36	29	7

Problem was omitted as it lacked support for T.O.

T.O. 19

Segment 13 #12

R1	R2	R3	R4
87	20	6	2

With the addition of several explanatory phrases, this problem is satisfactory for the new segment.

T.O. 41

Segment 13 #13

R1	R2	R3	R4
75	27	9	2

Question has been omitted since it lacks support for the T.O.

T.O. 42

Segment 13 #14

R1	R2	R3	R4
62	37	12	1

With some notation changes to avoid ambiguities, this item is satisfactory for the study guide.

T.O. 43

Segment 13 #15

R1	R2	R3	R4
37	29	21	26

Addition of this question would place too much emphasis on the distinction between inertial and gravitational masses and may cause confusion at this level. Therefore, this problem has been omitted.

T.O. 43

Segment 13 #16

R1	R2	R3	R4
27	29	28	27

Addition of this question would place too much emphasis on the distinction between inertial and gravitational masses and may cause confusion at this level. Therefore, this problem has been omitted.

T.O. 43

Segment 13 #17

R1	R2	R3	R4
88	18	3	0

With the change of format to true or false the question has been appropriately rephrased.

T.O. 42

Segment 13 #18

R1	R2	R3	R4
26	30	28	16

Now that all data is presented in the same unit system, this question is entirely satisfactory.

T.O. 42

Segment 13 #19

R1	R2	R3	R4
16	49	36	8

This problem has been entirely reworded to make explicit some assumptions students must make for its solution.

T.O. 42

Segment 13 #20

R1	R2	R3	R4
40	14	10	15

A valid but somewhat difficult problem, this item has been placed for enrichment.

T.O. 42

Segment 13 #21

RI	R2	R3	R4
77	23	4	1

Since a lever balance actually compares masses, wording was changed to clarify that point for the new study guide.

T.O. 42

Segment 13 #22

R1	R2	R3	R4
28	30	27	20

Problem is invalid since it does not support the T.O. and wording is ambiguous.

T.O. 44

Segment 13 #23

R1	R2	R3	R4
24	63	10	8

This problem is valid but a bit difficult. It is aided by the information panel.

T.O. 44

Segment 13 #24

R1	R2	R3	R4
70	25	8	1

This problem is valid but a bit difficult. It is aided by the information panel.

T.O. 44

Segment 14 #1

R1	R2	R3	R4
46	47	11	2

Although a valid question with satisfactory performance data, this item is out of sequence and does not support T.O.'s of this segment.

T.O. 45

Segment 14 #2

R1	R2	R3	R4
45	42	11	2

With a change in the solution for clarification this question will be used for the new version.

T.O. 45

Segment 14 #3

R1	R2	R3	R4
61	27	13	2

An acceptable question with good performance data.

T.O. 46

Segment 14 #4

R1	R2	R3	R4
33	14	10	12

This question should be combined with question 5 to form a self-standing problem.

T.O. 18

Segment 14 #5

R1	R2	R3	R4
42	34	21	5

This question should be combined with question 4 to form a self-contained problem.

T.O. 46

Segment 14 #6

R1	R2	R3	R4
52	32	9	5

With a slight modification of the correct solution this question is satisfactory.

T.O. 46

Segment 14 #7

R1	R2	R3	R4
47	25	16	9

A valid question to be preceded by an appropriate information panel.

T.O. 46

Segment 14 #8

R1	R2	R3	R4
19	16	14	10

A valid question for use in the new version study guide.

T.O. 46

Segment 14 #9

R1	R2	R3	R4
30	31	27	6

Question is a simple exercise in calculus.

T.O. 47

Segment 14 #10

R1	R2	R3	R4
12	30	35	15

An acceptable question in its present form for the new study guide.

T.O. 47

Segment 14 #11

R1	R2	R3	R4
19	13	8	11

No change is required for re-use of this question.

T.O. 47

Segment 14 #12

R1	R2	R3	R4
30	31	22	8

Does not contribute to understanding of concepts involving gravitation and therefore has been eliminated.

T.O. 48

Segment 14 #13

R1	R2	R3	R4
34	27	19	11

This is not an appropriate question to convey the principle of gravitation and therefore will not be used in the new segment.

T.O. 48

Segment 14 #14

R1	R2	R3	R4
36	25	6	3

Contains information which is more appropriate in an information panel.

T.O. 48

Segment 14 #15

R1	R2	R3	R4
15	32	30	13

A poor question since it confuses the student in making a choice of appropriate coordinate systems in calculating potential energy.

T.O. 48

Segment 14 #16

R1	R2	R3	R4
25	5	7	8

With modification of the correct answer this question has been used in the new version.

T.O. 48

Segment 14 #17

R1	R2	R3	R4
21	14	4	2

A valid item especially as an enrichment question.

T.O. 48

Segment 14 #18

R1	R2	R3	R4
40	18	18	9

With a modification of the correct solution this question should appear in the new segment.

T.O. 48

Segment 14 #19

R1	R2	R3	R4
21	13	6	3

This question has been clarified by replacing the phrase "...a very short time thereafter" with "instantaneously."

T.O. 48

Segment 14 #20

R1	R2	R3	R4
33	28	20	5

An acceptable question requiring no change for the new segment.

T.O. 48

Segment 14 #21

R1	R2	R3	R4
7	13	11	5

This question is ambiguous and not relevant to the course level.

T.O. 48

Segment 14 #22

R1	R2	R3	R4
12	33	21	15

A valid question for inclusion in the study guide. Performance data is attributed primarily to other factors as indicated.

T.O. 47

Segment 14 #23

R1	R2	R3	R4
17	23	21	20

Other questions better support the T.O. than this one.

T.O. 47

Segment 14 #24

R1	R2	R3	R4
17	8	3	3

Too difficult a question to be relevant to the level of the course.

T.O. 48

Segment 15 #1

R1	R2	R3	R4
17	29	28	5

A valid question which should be included in the new segment.

T.O. 48

Segment 15 #2

R1	R2	R3	R4
31	14	17	16

With modifications to clarify the question and amplify the solution this question will reappear in the new segment.

T.O. 48

Segment 15 #3

R1	R2	R3	R4
44	18	10	5

Rewriting the statement of the question makes this a valid core problem for the new version segment.

T.O. 48

Segment 15 #4

R1	R2	R3	R4
49	24	2	2

This question is both redundant and too trivial to be retained.

T.O. 48

Segment 15 #5

R1	R2	R3	R4
19	10	3	2

Omitted since other problems give better T.O. support.

T.O. 46

Segment 15 #6

R1	R2	R3	R4
16	9	3	2

Problem would be redundant since the T.O. has been adequately supported by other problems.

T.O. 47

Segment 15 #7

R1	R2	R3	R4
16	8	3	2

Problem would be redundant since the T.O. has been adequately supported by other problems.

T.O. 48

Segment 15 #8

R1	R2	R3	R4
40	17	12	6

This question is beyond the scope of this course and therefore will not appear in the new segment.

T.O. 48

Segment 15 #9

R1	R2	R3	R4
17	22	24	12

With minor changes of the wording of the correct solution this problem is valid for the new segment.

T.O. 45

Segment 15 #10

R1	R2	R3	R4
9	7	4	2

Corrections have been made of the correct solution to make this an acceptable problem.

T.O. 45

Segment 15 #11

RI	R2	R3	R4
9	10	1	3

This is a repetition of question 10 and therefore has not been included in new version.

T.O. 45

Segment 15 #13

R1	R2	R3	R4
7	7	5	1

A redundant item which does not appear in new study guide.

T.O. 45

Segment 15 #14

RI	R2	R3	R4
44	16	5	5

Question is not pertinent to T.O. involved and therefore has not been used again.

T.O. 45

Segment 15 #15

R1	R2	R3	R4
7	14	3	0

Question omitted since T.O. has been adequately covered by others.

T.O. 46

Segment 15 #16

R1	R2	R3	R4
11	5	3	3

A valid question needing only amplification of the solution to be retained in the segment.

T.O. 48

Segment 15 #17

R1	R2	R3	R4
13	4	2	3

With slight modifications of alternate answers B and D, and of the solution this problem is acceptable for use in the new segment.

T.O. 48

Segment 15 #18

R1	R2	R3	R4
13	2	2	0

A redundant question to be omitted from new version.

T.O. 48

Segment 15 #19

R1	R2	R3	R4
6	3	4	1

Correct solution has been modified to make this a more informative problem in the study guide.

T.O. 48

Segment 15 #20-24

Insufficient Data

Best suited for enrichment section.

T.O. 154

Segment 16 #1

R1	R2	R3	R4
99	12	3	0

Choice D was not an effective distractor. Change as shown.

T.O. 49

Segment 16 #2

R1	R2	R3	R4
55	39	17	3

With some rewriting of the statement "charge is quantized", this problem should remain otherwise unchanged. The explanation should be amplified.

T.O. 49

Segment 16 #3

R1	R2	R3	R4
100	7	4	3

A valid item, but needs some rewriting to increase differences between alternate choices.

T.O. 49

Segment 16 #4

R1	R2	R3	R4
87	20	4	3

This T.O. is better supported by other, more pertinent problems.

T.O. 49

Segment 16 #5

R1	R2	R3	R4
90	19	4	0

A valid item and necessary to the solution of coulomb forces.

T.O. 49

Segment 16 #6

R1	R2	R3	R4
87	19	4	3

A valid item and necessary to the solution of coulomb forces.

T.O. 49

Segment 16 #7

R1	R2	R3	R4
96	12	3	2

A valid question. Should remain unchanged.

T.O. 50

Segment 16 #8

R1	R2	R3	R4
100	7	1	2

T.O. has been adequately supported by other problems. The question will be used in enrichment section.

T.O. 50

Segment 16 #9

R1	R2	R3	R4
96	8	4	5

T.O. has been adequately supported by other problems. The question will be used in enrichment section.

T.O. 50

Segment 16 #10

R1	R2	R3	R4
102	9	1	0

This question compares quantity of charge to the flow of current and therefore is out of place in this segment on Electrostatics.

T.O. 51

Segment 16 #11

R1	R2	R3	R4
82	24	3	3

A valid item, highly supportive of the T.O., should remain unchanged.

T.O. 51

Segment 16 #12

R1	R2	R3	R4
49	46	9	8

This item is concerned with forces in terms of field strength and therefore is out of place in this segment.

T.O. 52

Segment 16 #13

R1	R2	R3	R4
60	32	11	9

This item is concerned with forces in terms of field strength and therefore is out of place in this segment.

T.O. 52

Segment 16 #14

R1	R2	R3	R4
21	17	39	35

This item is concerned with forces in terms of field strength and therefore is out of place in this segment.

T.O. 52

Segment 16 #15

R1	R2	R3	R4
37	23	33	18

Not valid. Correct answer not shown. Change to more believable numbers. The solution needs to be remedied. Its procedure is correct but the answer is not. This would account for the response data.

T.O. 49

Segment 16 #16

R1	R2	R3	R4
58	34	10	8

Problem does not support T.O. and has been omitted.

T.O. 49

Segment 16 #17

R1	R2	R3	R4
39	55	12	3

Other problems better support the T.O.

T.O. 54

Segment 16 #18

R1	R2	R3	R4
62	38	8	1

Appropriate T.O. has been adequately represented by other problems.

T.O. 54

Segment 16 #19

R1	R2	R3	R4
79	24	3	3

Problem should be eliminated since other items support T.O. better.

T.O. 54

Segment 16 #20

R1	R2	R3	R4
94	13	0	2

A good question on conservation of charge. Distractors should be changed as indicated to reduce triviality.

T.O. 54

Segment 16 #21

R1	R2	R3	R4
63	19	15	13

A good question on conservation of charge. Used for core question.

T.O. 54

Segment 16 #22

R1	R2	R3	R4
92	16	0	1

A good enabling question, requiring basic concepts of charging by conduction, and repulsion of like charges.

T.O. 54

Segment 16 #23

R1	R2	R3	R4
62	32	9	6

A valid item, requiring a knowledge of charging by induction and conduction, plus determination of nature of a charge. To be used in enrichment section.

T.O. 54

Segment 16 #24

R1	R2	R3	R4
95	8	4	3

A valid item, requiring a knowledge of charging by induction and conduction, plus determination of nature of a charge. To be used in enrichment section.

T.O. 54

Segment 17 #4

R1	R2	R3	R4
47	44	14	0

A valid question which requires some rearrangement of its form.

T.O. 53

Segment 17 #5

R1	R2	R3	R4
42	32	25	6

This question is suitable in original form.

T.O. 53

Segment 17 #6

R1	R2	R3	R4
50	39	14	2

Question is poorly worded and too confusing to the student to be included in the new segment.

T.O. 53

Segment 17 #8

R1	R2	R3	R4
56	40	6	1

Question is valid but unclear. Requires some rephrasing to be saved for new segment.

T.O. 55

Segment 17 #12

R1	R2	R3	R4
26	29	29	16

An already acceptable example of a classical problem.

T.O. 53

Segment 17 #14

R1	R2	R3	R4
29	37	20	12

Although a valid question, it should be preceded by simpler questions, accomplished by placing this one in a later segment.

T.O. 53

Segment 17 #17

R1	R2	R3	R4
34	28	21	12

An acceptable question in its present form.

T.O. 53

Segment 17 #18

R1	R2	R3	R4
45	36	10	3

With a modification of the correct solution, this question becomes acceptable for the new segment.

T.O. 53

Segment 17 #20

R1	R2	R3	R4
31	51	7	4

Does not lend support to T.O. and should be omitted.

T.O. 55

Segment 17 #21

R1	R2	R3	R4
27	32	23	12

Question is poorly stated. Since other questions adequately support the T.O. this one has been omitted.

T.O. 55

Segment 17 #23

R1	R2	R3	R4
28	50	10	6

Question is of a nature which is not relevant to this part of course.

T.O. 55

Segment 18 #6

R1	R2	R3	R4
41	26	28	13

Since the pertinent T.O. has been removed from this segment this problem will be used for enrichment segment.

T.O. 57

Segment 18 #11

R1	R2	R3	R4
35	53	19	3

The correct answer was incorrectly stated to be choice A instead of C. This would account for the poor performance indicated by the data. Otherwise, this is a valid item.

T.O. 56

Segment 18 #12

R1	R2	R3	R4
52	36	16	5

An acceptable question in its present form for the new segment.

T.O. 56

Segment 18 #13

R1	R2	R3	R4
42	41	16	11

A valid item which does not require changes or modifications for the new segment.

T.O. 58

Segment 18 #14

R1	R2	R3	R4
40	39	16	13

Pertinent T.O. has been removed from this segment. Therefore, this problem will appear in the enrichment segment.

T.O. 58

Segment 18 #17

R1	R2	R3	R4
36	30	14	26

Question is poorly worded and may tend to confuse students. Therefore, it has been omitted from the segment.

T.O. 58

Segment 18 #18

R1	R2	R3	R4
18	36	46	6

A poorly worded question, whose T.O. has been moved to the enrichment section, finds itself also so moved.

T.O. 59

Segment 18 #22

R1	R2	R3	R4
52	47	2	1

This item is out of sequence if placed in this segment.

T.O. 49

Segment 19 #2

R1	R2	R3	R4
41	44	17	2

A valid question, applicable to the new version segment.

T.O. 60

Segment 19 #6

R1	R2	R3	R4
35	33	17	15

This item is most appropriate in a segment on work and potential.

T.O. 63

Segment 19 #7

R1	R2	R3	R4
48	29	17	7

A good example of one of those classical problems in this area of study.

T.O. 60

Segment 19 #8

R1	R2	R3	R4
39	36	16	6

An acceptable problem which is out of place in this segment.

T.O. 62

Segment 19 #10

R1	R2	R3	R4
49	44	5	0

No change is required in this acceptable problem.

T.O. 61

Segment 19 #12

R1	R2	R3	R4
43	40	12	2

Acceptable for new segment in this present form.

T.O. 61

Segment 19 #15

R1	R2	R3	R4
37	25	18	11

A valid item for re-use in the new segment.

T.O. 52

Segment 19 #16

R1	R2	R3	R4
33	26	8	22

Use of this item is not valid. It is duplication of a question in the segment on gravitation.

T.O. 41

Segment 19 #17

R1	R2	R3	R4
34	37	12	5

This item properly belongs in the segment on work and potential.

T.O. 63

Segment 19 #18

R1	R2	R3	R4
27	16	24	23

With the omission of the phrase "neglect relativistic effects" this problem will be used in the new segment.

T.O. 61

Segment 19 #19

R1	R2	R3	R4
22	26	20	17

A problem requiring no changes for its re-use. Performance data is attributed primarily to other factors as indicated.

T.O. 61

Segment 19 #20

R1	R2	R3	R4
36	20	17	10

A question too sophisticated for this level course. Place in enrichment section.

T.O. 63

Segment 19 #21

R1	R2	R3	R4
42	22	15	6

A good question in its present form for re-use.

T.O. 60

Segment 19 #23

R1	R2	R3	R4
41	28	11	6

Question is poorly worded and confusing to the students. Omitted from new version of the segment.

T.O. 62

Segment 19 #24

R1	R2	R3	R4
42	19	15	10

Item does not test for comprehension of the desired T.O. and thus has been omitted.

T.O. 52

Segment 23 #8

R1	R2	R3	R4
41	17	22	23

Item valid. Question valid.

Segment 23 #11

R1	R2	R3	R4
41	51	8	3

Item valid. Question valid. Performance data is probably due to other factors as indicated.

Segment 23 #13

R1	R2	R3	R4
38	52	11	2

Item valid. Question valid. Omit, as there are too many redundant flux questions in this segment.

Segment 24 #1

R1	R2	R3	R4
40	39	10	4

Item valid in present form requiring no modifications.

T.O. 67

Segment 24 #9

R1	R2	R3	R4
38	31	17	3

The problem now includes the charge on an alpha particle which students had been expected to know.

T.O. 68

Segment 24 #12

R1	R2	R3	R4
34	31	20	4

The relevant T.O. has been sufficiently emphasized by other questions.

T.O. 67

Segment 24 #18

R1	R2	R3	R4
44	30	7	6

This item tests for information too trivial to this segment and therefore has been omitted.

T.O. 69

Segment 24 #19

R1	R2	R3	R4
31	38	13	5

A conceptually confusing problem which has been omitted.

T.O. 69

Segment 24 #20

R1	R2	R3	R4
22	49	8	8

An acceptable problem for re-use in the course.

T.O. 69

Segment 24 #21

R1	R2	R3	R4
35	37	7	9

Question has been retained since it tests for concepts required by the T.O.

T.O. 68

Segment 24 #23

R1	R2	R3	R4
31	39	13	3

Essentially, this question duplicates efforts of question 20 which has been given preference.

T.O. 68

Segment 25 #5

R1	R2	R3	R4
22	19	14	7

For irrelevance to the understanding of concepts in this segment this question has been omitted.

T.O. 67

Segment 25 #9

R1	R2	R3	R4
21	19	15	7

Although a valid question, its T.O. has been removed from the segment and so, therefore, has this problem.

T.O. 70

Segment 25 #10

R1	R2	R3	R4
27	28	5	3

Although a valid question, its T.O. has been removed from the segment and so, therefore, has this problem.

T.O. 70

Segment 25 #12

R1	R2	R3	R4
23	20	10	9

Too complex for use as a study guide question.

T.O. 70

Segment 25 #13

R1	R2	R3	R4
11	18	16	19

Question properly supports T.O. and will be re-used.

T.O. 52

Segment 25 #16

R1	R2	R3	R4
26	19	16	2

Omitted since T.O. is adequately treated in other questions.

T.O. 69

Segment 25 #18

R1	R2	R3	R4
21	21	14	6

With a slight modification of the correct answer, this question should be re-used in study guide.

T.O. 69

Segment 25 #21

R1	R2	R3	R4
23	16	12	11

Correct solution has been modified and clarified so that this question may be used in the new version segment.

T.O. 68

Segment 26 #14

R1	R2	R3	R4
41	35	11	13

Although a valid question, it has been replaced by a similar better worded question.

T.O. 74

Segment 26 #19

R1	R2	R3	R4
21	13	15	13

Problem is entirely satisfactory in its present form for the new segment.

T.O. 75

Segment 26 #22

R1	R2	R3	R4
13	11	6	14

Problem is entirely satisfactory in its present form for the new segment.

T.O. 75

Segment 26 #23

R1	R2	R3	R4
13	10	6	9

Inclusion of this question would be redundant and therefore it will be used in the enrichment segment.

T.O. 75

Segment 27 #2

R1	R2	R3	R4
23	14	10	22

A valid item for use, without modifications, in the new segment.

T.O. 76

Segment 27 #7

R1	R2	R3	R4
34	22	7	6

Question contains a process of approximation which would be most appropriate in an enrichment segment.

T.O. 73

Segment 27 #8

R1	R2	R3	R4
28	32	6	3

Rated G. (A good standard problem for inclusion in the study guide.)

T.O. 73

Segment 27 #9

R1	R2	R3	R4
25	24	13	7

Inclusion of this problem would cause redundancy. Therefore, it has been omitted.

T.O. 53

Segment 27 #16

R1	R2	R3	R4
33	19	14	3

A valid question which properly tests the T.O.

T.O. 78

Segment 27 #17

R1	R2	R3	R4
23	25	10	10

A valid question which properly tests the T.O.

T.O. 78

Segment 27 #18

R1	R2	R3	R4
12	9	2	13

This question, although valid, is confusing to the students and has been eliminated from the new study guide.

T.O. 79

Segment 27 #20

R1	R2	R3	R4
11	10	4	8

With a minor modification this problem is suitable for inclusion in the new study guide.

T.O. 79

Segment 27 #22

R1	R2	R3	R4
16	14	3	1

Inclusion of this problem could create redundancy. It has therefore been eliminated from the new version.

T.O. 79

Segment 27 #23

R1	R2	R3	R4
13	8	3	5

Use of this question here is not valid. This problem has been given in an earlier segment for the calculation of potential difference.

T.O. 79

Segment 27 #24

R1	R2	R3	R4
12	13	3	1

A valid question appropriate to the T.O. of concern.

T.O. 79

Segment 28 #9

R1	R2	R3	R4
31	49	17	9

Alternate answers A and C are too similar in the original question. They require modification to make this an acceptable question for the new segment.

T.O. 81

Segment 28 #12

R1	R2	R3	R4
43	23	21	19

An item requiring no modification for re-use. Performance data is attributed primarily to other factors as indicated.

T.O. 82

Segment 28 #14

R1	R2	R3	R4
27	59	12	8

The inclusion of a circuit diagram should prove helpful to the students in this problem.

T.O. 82

Segment 28 #15

R1	R2	R3	R4
43	26	17	20

Inclusion of the appropriate circuit diagram will make this problem self-contained.

T.O. 82

Segment 28 #17

R1	R2	R3	R4
22	39	27	14

Since this question is acceptable, the performance data suggests the need for additional problems for practice in the calculation of the energy of an electric field.

T.O. 82

Segment 28 #18

R1	R2	R3	R4
43	32	26	4

A valid problem which does not require modifications.

T.O. 83

Segment 28 #19

R1	R2	R3	R4
48	43	11	1

This question has been omitted since it contains an ambiguous scatement and is not pertinent to the subject content.

T.O. 83

Segment 28 #23

R1	R2	R3	R4
36	44	17	3

A valid question which is pertinent to the T.O.

T.O. 83

Segment 28 #24

R1	R2	R3	R4
49	37	10	4

The question is valid and should be located ahead of items 22 and 23.

T.O. 83

Segment 29 #2

R1	R2	R3	R4
43	28	16	9

This item does not require modifications to suit new segment.

T.O. 84

Segment 29 #3

R1	R2	R3	R4
47	37	5	7

T.O. for this question is better supported by question #4 which has received preference.

T.O. 84

Segment 29 #9

R1	R2	R3	R4
37	35	14	6

This item does not require modifications to suit new segment.

T.O. 84

Segment 29 #11

R1	R2	R3	R4
40	37	14	0

An acceptable question in present form.

T.O. 84

Segment 29 #15

R1	R2	R3	R4
15	26	21	25

Question is acceptable for re-use in the new segment. Performance data is attributed primarily to other factors as indicated.

T.O. 85

Segment 29 #18

R1	R2	R3	R4
43	25	12	7

Question is acceptable for re-use in the new segment.

T.O. 86

Segment 29 #20

R1	R2	R3	R4
17	15	15	8

A valid question but not pertinent to T.O. It has been moved to the previous segment.

T.O. 82

Segment 29 #22

R1	R2	R3	R4
12	17	9	5

Question is valid but of place in this segment.

T.O. 83

Segment 29 #24

R1	R2	R3	R4
16	9	4	4

Question is beyond the scope of the course and therefore has been removed for placement in enrichment.

T.O. 85

Segment 30 #7

R1	R2	R3	R4
39	36	11	10

Item valid in present form for use in new segment.

T.O. 88

Segment 30 #8

R1	R2	R3	R4
36	26	18	15

Item valid in present form for use in new segment.

T.O. 88

Segment 30 #12

R1	R2	R3	R4
33	40	12	9

A valid item which tests concepts pertinent to the T.O.

T.O. 89

Segment 30 #13

R1	R2	R3	R4
34	37	11	11

A good, standard question requiring no modification for its re-use.

T.O. 89

Segment 30 #14

R1	R2	R3	R4
48	28	12	2

A valid item which tests concepts pertinent to the T.O.

T.O. 88

Segment 30 #16

R1	R2	R3	R4
32	12	27	19

Question has been removed since it is confusing and too trivial.

T.O. 90

Segment 30 #21

R1	R2	R3	R4
41	22	15	9

A valid problem, requires the rewriting of the correct answer to be used in new segment.

T.O. 90

Segment 31 #6

R1	R2	R3	R4
37	26	8	8

A valid question which tests for concepts required for T.O.

T.O. 91

Segment 31 #8

R1	R2	R3	R4
40	30	4	3

A satisfactory question in present form for re-use.

T.O. 91

Segment 31 #13

R1	R2	R3	R4
32	23	6	15

This question supports the pertinent T.O. and will be re-used.

T.O. 91

Segment 31 #15

R1	R2	R3	R4
30	15	18	9

No change is required to re-use this acceptable question.

T.O. 92

Segment 31 #24

R1	R2	R3	R4
24	13	6	2

Question is too tedious and cumbersome for use here. Kirchhoff's rules can be learned through much simpler circuits. This problem should be used in enrichment.

T.O. 93

Segment 32 #2

R1	R2	R3	R4
19	17	12	2

A valid question. Does not require modifications for re-use.

T.O. 94

Segment 32 #3

R1	R2	R3	R4
18	16	9	7

Question tests for concepts desired for the T.O. and will be re-used.

T.O. 94

Segment 32 #5

R1	R2	R3	R4
14	16	15	2

An acceptable question for re-use without modifications.

T.O. 94

Segment 32 #6

R1	R2	R3	R4
19	17	7	4

An acceptable question for re-use without modifications.

T.O. 95

Segment 32 #7

R1	R2	R3	R4
16	12	10	8

Question tests for concepts required for T.O. and will be re-used.

T.O. 91

Segment 32 #8

R1	R2	R3	R4
21	18	4	2

A valid question to test for concepts needed for understanding T.O.

T.O. 95

Segment 32 #10

R1	R2	R3	R4
16	7	11	9

An acceptable question for use in the new version study guide.

T.O. 95

Segment 32 #13

R1	R2	R3	R4
18	9	6	3

Requires no change for use in new segment.

T.O. 96

Segment 32 #14

R1	R2	R3	R4
16	10	6	1

A valid question to test concepts necessary for understanding of T.O.

T.O. 96

Segment 32 #15

R1	R2	R3	R4
16	5	10	4

Question in original form is a little too difficult. An illustration with some hints for solution will be helpful.

T.O. 91

Segment 32 #19

R1	R2	R3	R4
8	8	1	2

Although a valid question, this topic was covered in an earlier segment and therefore question has been omitted.

T.O. 93

Segment 32 #22

R1	R2	R3	R4
5	6	1	1

Although a valid question, this topic was covered in an earlier segment and therefore question has been omitted.

T.O. 22

Segment 33 #2

R1	R2	R3	R4
32	47	5	2

A valid question for use in its present form.

T.O. 99

Segment 33 #3

R1	R2	R3	R4
37	28	15	6

Slight modifications have been made of the included diagram and the correct solution to improve their clarity to the student.

T.O. 99

Segment 33 #4

R1	R2	R3	R4
41	26	9	9

No changes are required for re-use of this question.

T.O. 97

Segment 33 #5

R1	R2	R3	R4
33	39	6	4

Slight modifications have been made of the included diagram and the correct solution to improve their clarity to the student.

T.O. 100

Segment 33 #6

R1	R2	R3	R4
27	42	8	4

A good question in present form which should succeed questions 24, 20, 21 of old segment 34.

T.O. 100

Segment 33 #7

R1	R2	R3	R4
38	21	13	6

A satisfactory question to test for the required T.O.

T.O. 100

Segment 33 #10

R1	R2	R3	R4
24	24	25	6

This is an acceptable question for use in the new version of the study guide.

T.O. 102

Segment 33 #11

R1	R2	R3	R4
32	29	13	2

With some additions to the correct solution, for completeness makes this an acceptable problem to use in the new segment.

T.O. 102

Segment 33 #13

R1	R2	R3	R4
29	33	10	1

No changes were deemed necessary for the re-use of this question.

T.O. 102

Segment 33 #16

R1	R2	R3	R4
31	19	8	11

Except for a slight modification to clarify the correct solution, this problem is otherwise unchanged for the new segment.

T.O. 103

Segment 33 #17

R1	R2	R3	R4
31	23	14	1

A poor question to test for the required T.O. It has been eliminated from the segment.

T.O. 104

Segment 33 #19

R1	R2	R3	R4
27	20	8	9

The only modifications of this problem were made in the included diagram.

T.O. 105

Segment 33 #20

R1	R2	R3	R4
27	16	16	7

This problem will be re-employed in the new segment without changes.

T.O. 105

Segment 33 #22

R1	R2	R3	R4
27	26	7	4

This question properly tests for the required T.O. and will be retained for use in the new segment.

T.O. 105

Segment 33 #23

R1	R2	R3	R4
26	25	8	5

This question will appear without change in the new study guide.

T.O. 105

Segment 33 #24

R1	R2	R3	R4
22	13	11	17

With improvements made in the analysis of the solution, this problem will be re-used. Performance data is attributed primarily to other factors as indicated.

T.O. 105

Segment 34 #2

R1	R2	R3	R4
18	18	11	4

The statement of the question is poorly worded and, consequently, confusing to the students. This question has been omitted.

T.O. 106

Segment 34 #3

R1	R2	R3	R4
24	16	6	4

An acceptable problem to test for the required T.O. without needing any modifications.

T.O. 106

Segment 34 #4

R1	R2	R3	R4
14	11	13	11

This question may be re-used without any modifications. Performance data is attributed primarily to other factors as indicated.

T.O. 106

Segment 34 #5

R1	R2	R3	R4
23	12	11	4

A valid item which does not require changes for use in the new segment.

T.O. 106

Segment 34 #6

R1	R2	R3	R4
23	23	2	2

An acceptable question in its present form.

T.O. 100

Segment 34 #8

R1	R2	R3	R4
18	12	12	5

This question properly supports the T.O. and may be used in the new segment.

T.O. 106

Segment 34 #9

R1	R2	R3	R4
23	15	6	3

This question is essentially a simple mechanics problem which does not support the T.O. and, therefore, has been eliminated.

T.O. 106

Segment 34 #10

R1	R2	R3	R4
18	20	5	4

Other questions better support the T.O. and have been chosen in preference to this one.

T.O. 98

Segment 34 #14

R1	R2	R3	R4
15	15	4	3

A valid question for testing the skills required by the T.O.

Segment 34 #15

R1	R2	R3	R4
11	11	10	4

This question has been modified to eliminate areas that are potentially confusing.

T.O. 100

Segment 34 #22

R1	R2	R3	R4
13	12	3	7

Solution of this question requires merely substitution into the appropriate equation. This question does not sufficiently teach the principles of physics required for the T.O. and has been omitted from the new segment.

T.O. 52

Segment 34 #23

R1	R2	R3	R4
11	12	6	6

This question requires some modification to clarify its meaning. With the appropriate changes it becomes acceptable for use in the new segment.

T.O. 100

Segment 34 #24

R1	R2	R3	R4
9	6	11	9

An acceptable question in its present form, and will be present in the new segment. Performance data is attributed primarily to other factors as indicated.

T.O. 9

Segment 35 #1

R1	R2	R3	R4
14	13	5	1

An acceptable question to test for skills required by the T.O.

T.O. 101

Segment 35 #2

R1	R2	R3	R4
13	9	10	1

No modifications are necessary to use this question in the new segment. Performance data is attributed primarily to other factors as indicated.

T.O. 101

Segment 35 #3

R1	R2	R3	R4
14	7	7	4

This question properly tests for knowledge necessary for an understanding of the appropriate T.O. and will appear in the new segment.

T.O. 101

Segment 35 #6

R1	R2	R3	R4
10	11	7	4

The correct answer requires a correction to make this an acceptable problem for the new segment.

T.O. 101

Segment 35 #7

R1	R2	R3	R4
7	12	6	6

A valid item to test for the skills necessary for an understanding of the T.O. and will be used in the new version of the study guide. Performance data is attributed to other factors as indicated.

T.O. 102

Segment 35 #9

R1	R2	R3	R4
10	11	5	1

A valid item to test for the skills necessary for an understanding of the T.O. and will be used in the new version of the study guide.

T.O. 99

Segment 35 #10

R1	R2	R3	R4
7	5	10	3

Inclusion of this question would be redundant since the appropriate T.O. has been thoroughly covered in a previous segment.

T.O. 106

Segment 35 #11

R1	R2	R3	R4
11	8	2	4

Inclusion of this question would be redundant since the appropriate T.O. has been thoroughly covered in a previous segment.

T.O. 21

Segment 35 #12-24

Too few students worked this part of the segment to give meaningful data.

Segment 36 #3

R1	R2	R3	R4
16	24	21	7

A discussion about Ampere's law in the information panel should help in understanding skills required by this question.

T.O. 108

Segment 36 #6

R1	R2	R3	R4
23	11	6	26

This question is confusing and therefore has been omitted from the study guide.

T.O. 108

Segment 36 #8

R1	R2	R3	R4
21	20	13	9

A valid question which requires re-organization to be acceptable for the new segment.

T.O. 109

Segment 36 #11

R1	R2	R3	R4
19	16	12	12

This item is out of place in this segment and will be omitted from the new study guide.

T.O. 99

Segment 36 #12

R1	R2	R3	R4
15	18	13	10

In the arrangement of the new segment this problem has been placed in a better sequence.

T.O. 102

Segment 36 #13

R1	R2	R3	R4
15	18	13	10

A valid problem requiring only modification of the solution for use in the new study guide.

T.O. 102

Segment 36 #17

R1	R2	R3	R4
19	27	2	1

In the arrangement of the new segment this problem has been placed in a better sequence.

T.O. 102

Segment 36 #18

R1	R2	R3	R4
15	29	4	2

This question has been eliminated from the study guide since it is confusing to the students and other problems better support the T.O.

T.O. 108

Segment 36 #21

R1	R2	R3	R4
12	19	0	18

A valid question which will be retained for the new study guide. Performance data is attributed primarily to other factors as indicated.

T.O. 110

Segment 37 #1

R1	R2	R3	R4
14	16	10	8

In the new segment, other questions will precede this item in order to develop skills needed for its solution.

T.O. 112

Segment 37 #2

R1	R2	R3	R4
15	16	8	9

The correct solution requires some modifying to eliminate confusing areas and make this question acceptable for the new study guide.

T.O. 112

Segment 37 #5

R1	R2	R3	R4
14	14	7	8

This question has been rewritten in a more explicit form for the new segment.

T.O. 113

Segment 37 #10

R1	R2	R3	R4
16	17	6	1

A good question, but out of place in this segment. This question belongs in the following segment.

T.O. 114

Segment 37 #18

R1	R2	R3	R4
8	19	7	3

A good question, but out of place in this segment. This question belongs in the following segment placed after question 10.

T.O. 114

Segment 37 #22

R1	R2	R3	R4
12	12	8	3

A good question, but out of place in this segment. This question belongs in the following segment.

T.O. 116

Segment 37 #23

R1	R2	R3	R4
13	16	3	3

A discussion of the sign convention should be included in the information panel preceding this question to adequately prepare the students.

T.O. 116

Segment 38 #1

R1	R2	R3	R4
6	6	7	2

This is not a valid question to test for an understanding of the T.O. and has been omitted from the segment.

T.O. 111

Segment 38 #2

R1	R2	R3	R4
9	7	2	2

This is not a valid question to test for an understanding of the T.O. and has been omitted from the segment.

T.O. 111

Segment 38 #3-24

Insufficient Data

Too few students participated in these questions to give meaningful data.

Segment 39 #6

R1	R2	R3	R4
26	30	10	2

This item will be placed in a more favorable position in the new segment.

T.O. 117

Segment 39 #9

R1	R2	R3	R4
33	21	6	7

A valid question, from which superfluous information has been eliminated, for use in the new version study guide.

T.O. 117

Segment 39 #10

R1	R2	R3	R4
32	20	11	3

No changes are necessary to use this question in the new segment.

T.O. 118

Segment 39 #12

R1	R2	R3	R4
17	20	8	9

This question has been rewritten to remove ambiguities contained in the original version.

T.O. 158

Segment 39 #16

R1	R2	R3	R4
29	30	11	5

This is an acceptable question, in its present form, to test for skills required for the T.O.

T.O. 120

Segment 39 #20

R1	R2	R3	R4
28	18	12	4

This question has been removed since its inclusion would be redundant.

T.O. 120

Segment 39 #21

R1	R2	R3	R4
20	13	18	11

An information panel discussing the magnetic field energy density will precede this question in the new study guide.

T.O. 120

Segment 40 #3

R1	R2	R3	R4
19	15	15	8

This question is too trivial for inclusion at this stage of the course.

T.O. 121

Segment 40 #3

R1	R2	R3	R4
25	20	8	4

This question is too trivial for inclusion at this stage of the course.

T.O. 121

Segment 40 #13

R1	R2	R3	R4
17	14	12	10

Modifications have been made to clarify the meaning of this question.

T.O. 122

Segment 40 #14

R1	R2	R3	R4
21	19	7	6

The correct solution has been rewritten and this question has been placed in a more appropriate position in the new study guide.

T.O. 121

Segment 40 #15

R1	R2	R3	R4
21	13	9	9

A valid question which will be of most benefit in the enrichment segment.

T.O. 121

Segment 40 #16

R1	R2	R3	R4
21	21	8	1

An acceptable question in its present form for the new segment.

T.O. 123

Segment 40 #22

R1	R2	R3	R4
18	23	2	4

An acceptable question which will be placed in a more favorable position in the new study guide.

T.O. 121

VIII OBJECTIVES INDEX AND DATA COMPILATION

A tabulation of the major data used in revision (listed by objective).

OBJECTIVES INDEX AND DATA COMPILATION

Explanation of Column Headings

PRETEST	--	Item	Problem identified by volume letter and number
		C(U/L)	Average percentage correct (In this column U/L does not apply)
POSTTEST	--	Item	Problem identified by volume letter and number
		L.C.	Learning Category
		C(U/L)	Average percentage correct (upper half/lower half)
FINAL	--	Item	Problem number
		M/F	Multiple choice/Fill-in
		C(U/L)	Average percentage correct (upper half/lower half)
STUDY GUIDE	--	Item	Problem identified by volume letter, grouping, and number
		One Punch	Number of students selecting one answer to the item
		Two, Three, and Four Punch	Number of students selecting two, three, or four answers to the item
		E.O.	Enabling objective for item
(AV)	--		The notation "(AV)" in the Terminal Objective column indicates that audio-visuals are associated with that objective

	PRETEST		POSTTEST			FINAL			STUDY GUIDE				
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
1	A7	47	A7	1	45(68/22)				A1-1	108	16	1	1	01
									A1-2	113	9	1	0	02
									A1-3	107	19	3	1	03
									A1-4	60	56	12	0	04
									A1-5	111	17	2	1	05
									A1-6	104	24	1	2	06
									A1-7	50	53	21	7	07
2	A3	57	A3	0	51(63/40)				A1-8	97	29	4	0	01
3	A1	11	A1	1	42(52/31)				A1-9	63	46	19	2	01
									A1-10	27	72	25	7	02
									A1-11	25	84	16	6	03
									A1-12	95	23	11	1	04
4	A2	36	A2	1	55(72/39)	1	F	95(97/92)	A1-13	68	38	11	11	01
			H1	1	99(98/100)				A1-14	61	41	21	5	02
									A1-15	78	34	13	4	01
									A1-16	59	57	12	0	03
									A1-17	52	48	20	9	04
									A1-18	74	30	12	13	05
									A1-19	97	15	1	4	81
									A1-20	104	9	0	1	82
									A1-21	67	24	13	10	82
									A1-22	46	35	22	11	01
									A1-23	38	22	25	27	83
									A1-24	77	26	10	3	84
									A3-16	18	22	8	7	00
5	A5	2	A5	0	48(61/34)				A2-1	99	30	4	0	01
									A2-2	102	26	4	0	02
									A2-3	122	9	1	0	03
									A2-4	109	13	3	0	04

	PRETEST		POSTTEST			FINAL			STUDY GUIDE				
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
6	A9	48	A9	2	32(44/21)	2	M	71(78/63)	A2-5	105	22	5	1	01
			H2	2	70(81/60)				A2-6	93	32	7	0	01
									A2-7	53	76	3	0	02
									A2-8	74	33	19	5	03
									A2-9	43	28	44	15	04
									A2-19	93	26	3	1	05
									A3-11	49	21	5	1	00
									A3-20	18	16	8	1	00
									D2-8	33	22	12	4	00
7	A8	4	A8	0	56(71/42)	3	M	75(84/67)	A2-10	117	12	1	1	01
			H3	0	50(61/39)				A2-11	99	23	5	2	02
									A2-13	58	59	10	3	03
8	A4	4	A4	1	19(31/6)	4	M	60(71/49)	A2-12	57	50	14	8	01
9	A10	2	A10	1	29(44/14)				A2-14	96	29	2	1	01
									A2-15	95	23	2	6	01
									A2-16	51	55	17	4	02
									A2-17	83	27	12	4	03
									A2-18	30	41	37	16	05
									A3-4	47	34	13	4	02
									A3-7	39	31	15	5	01
									A3-13	28	16	16	11	00
									M2-24	9	6	11	9	00
10	A11	1	A11	1	52(63/42)	5	F	57(67/48)	A2-20	105	13	1	2	01
									A3-12	46	15	12	3	00
									A3-15	26	15	9	7	00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)	STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
11	A6	20	A6	2	53(75/31)	6	F	71(81/60)	A2-21	51	36	23	9	01
									A2-22	41	45	18	13	01
									A2-23	44	46	15	12	02
									A2-24	67	29	19	1	03
									A3-14	25	25	12	3	00
12 (AV)	A12	12	A12	1	33(51/15)	8	M	47(59/35)	A3-1	74	16	7	2	01
									A3-2	80	9	2	5	02
									A3-3	58	23	14	4	03
									A3-5	53	25	9	10	04
									A3-6	33	25	29	10	04
									A3-8	59	21	7	2	05
									A3-9	45	29	10	4	00
									A3-10	44	19	12	7	00
									A3-17	35	10	6	1	00
									A3-18	24	14	4	7	06
									A3-19	25	11	7	1	07
									M2-20	16	3	11	7	00
									M2-21	15	9	7	5	00
13 (AV)	B1	50	B1	0	96(98/94)	7	M	38(48/28)	B1-1	110	18	1	0	
									B1-2	125	4	0	0	
									B1-3	115	13	1	0	
									B1-4	43	78	8	0	
									B1-10	37	39	23	30	
									B1-11	65	50	12	2	
									B1-14	54	47	21	6	
									B1-15	83	32	9	2	
									B1-16	89	30	7	0	
									B1-17	92	17	11	6	
									B1-18	55	51	17	3	
									B1-19	37	51	35	3	
									B1-24	63	6	0	3	
									B2-12	88	10	10	2	
									B2-13	95	13	1	1	
									B3-17	29	22	10	2	

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)	STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
14	B2	42	B2	2	94(98/90)	9	F	96(98/94)	B1-5	121	8	0	0	01
(AV)			H4	2	98(99/98)				B1-6	122	6	0	1	02
									B1-13	53	26	34	15	00
									B2-1	57	19	16	29	03
									B2-2	73	39	6	3	04
									B2-3	38	37	33	12	05
									B2-9	60	37	16	4	06
									B2-10	58	36	13	7	07
									B2-11	80	24	6	2	08
									B2-15	65	30	14	0	09
									B2-16	51	40	15	3	10
									B2-17	25	37	39	8	11
									B2-18	88	19	0	2	12
									B2-22	42	25	20	10	13
									B2-23	35	36	20	4	14
									B3-19	31	15	10	7	02
									C3-21	8	1	0	0	00
									M1-12	40	14	6	4	00
									M3-12	13	3	4	2	00
									M3-15	8	5	6	2	00
15	B3	3	B3	3	54(74/34)	12	M	72(84/59)	B1-7	106	10	1	0	01
									B1-8	58	38	20	2	02
									B1-9	60	37	16	4	00
									B1-12	88	10	10	2	03
16	B5	8	B5	2	30(46/13)	10	F	60(72/47)	B1-20	102	21	1	2	01
									B1-21	53	58	15	0	00
									B1-22	62	50	11	2	03
									B1-23	115	5	2	3	04
									D1-8	79	22	20	1	00

	PRETEST		POSTTEST			FINAL			STUDY GUIDE					
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
17	B6	3	B6	2	0(1/0)	11	F	44(56/31)	B2-4	48	36	26	9	01
			H5	1	61(80/42)				B2-5	75	26	11	6	02
									B2-6	74	31	8	5	03
									B2-7	106	10	1	0	04
									B2-8	58	38	20	2	05
									B2-14	87	4	12	6	06
									B2-19	60	36	8	1	02
									B2-20	44	42	16	2	07
									B2-21	49	43	7	0	08
									B2-24	39	27	17	10	00
									E3-12	13	8	1	2	00
18	B7	0	B7	3	30(45/14)	13	M	58(71/45)	B3-1	78	7	3	1	01
									B3-2	86	2	1	0	02
									B3-3	70	16	2	1	03
									B3-4	73	14	2	0	04
									B3-5	57	19	10	3	05
									B3-6	49	35	5	0	06
									B3-7	56	14	7	6	00
									B3-8	47	32	4	0	08
									B3-9	40	18	15	8	09
									B3-10	56	20	2	0	10
									B3-11	48	11	9	7	11
									B3-15	31	20	14	3	12
									E2-4	33	14	10	12	00

	PRETEST		POSTTEST			FINAL			STUDY GUIDE					
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
19	B4	0	B4	2	25(42/8)	14	M	63(82/45)	B3-12	58	13	1	1	01
			H6	1	40(53/27)				B3-13	6	38	23	4	02
									B3-14	53	8	6	2	03
									B3-16	38	22	3	1	04
									B3-18	5	16	27	15	04
									B3-20	12	21	21	5	05
									B3-21	17	18	13	11	04
									B3-22	15	31	11	2	06
									B3-23	25	19	10	5	00
									B3-24	16	14	20	8	04
									E1-11					00
20 (AV)	C1	15	C1	1	88(96/79)	15	M	75(88/63)	C1-1	103	17	1	0	01
			H7	3	93(98/88)				C1-2	86	15	13	7	02
									C1-3	65	39	11	6	01
									C1-7	32	58	22	8	01
									C1-8	36	32	26	27	01
21 (AV)	C2	2	C2	2	47(65/29)	16	F	27(41/13)	C1-4	69	38	11	2	01
									C1-5	32	27	5	7	02
									C1-6	63	27	14	17	00
									C1-9	35	37	33	16	03
									C1-10	43	36	26	14	04
									M3-11	11	8	2	4	00
									M2-17	20	9	4	5	00
22	C3	1	C3	1	89(96/82)	17	F	36(50/23)	C1-11	72	15	14	16	01
			H8	1	88(96/80)				C1-12	55	44	13	5	01
									C1-13	57	38	11	9	01
									C1-24	16	13	6	4	01
									C3-16	12	6	5	0	00
									L3-22	5	6	1	1	00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)	STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
23 (AV)	C4	0	C4	2	44(63/25)				C1-14	33	29	30	21	01
									C1-15	67	31	11	3	02
									C1-16	42	22	16	7	03
									C1-17	37	7	8	13	04
									C1-18	16	26	12	8	05
									C1-19	25	25	7	0	06
									C1-20	30	18	5	2	07
									C1-21	23	16	8	6	00
									C1-22	21	13	5	10	00
									C1-23	17	10	9	6	00
									M2-13	22	14	1	2	00
24	C5	0	C5	0	76(95/57)	18	M	72(83/61)	C2-1	76	25	3	1	01
25 (AV)	C6	11	C6	3	85(98/72)	19	F	27(38/16)	C2-2	64	19	10	8	01
									C2-3	59	20	12	8	02
									C2-4	49	30	13	6	00
									C2-18	10	3	2	2	03
26	C7	5	C7	1	16(29/3)				C2-5	25	32	29	10	01
									C2-6	38	38	12	4	02
									C2-7	33	41	13	1	03
									C2-8	39	34	15	1	04
									C2-9	36	41	10	2	03

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
27	C8	1	C8	1	58(51/34)	20	F	81(91/70)
(AV)			H9	1	79(91/66)			
28	C9	2	C9	3	89(97/81)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
C2-10	66	20	3	0	01
C2-11	45	24	9	9	02
C2-12	35	35	14	0	03
C2-13	70	8	4	3	04
C2-14	71	9	3	2	04
C2-15	35	15	15	19	04
C2-16	29	9	4	5	04
C2-17	13	10	2	0	00
C2-19	6	4	3	0	05
C2-20	7	6	0	0	05
C2-21	4	5	3	0	00
C2-22	6	4	0	1	06
C2-23	5	6	0	0	06
C2-24	6	2	0	3	06
C3-18	5	4	0	0	00
C3-19	4	2	1	2	00
C3-20	4	1	3	1	00
L1-6	88	6	1	1	00
M3-16	12	4	2	3	00
C3-1	59	16	2	0	01
C3-2	61	15	0	1	02
C3-3	59	9	5	3	03
C3-4	57	17	1	0	04
C3-5	62	6	2	4	05
C3-6	68	3	2	1	06
C3-7	69	5	0	0	07
C3-8	46	22	2	3	08
C3-9	36	28	5	0	09
C3-10	39	14	9	5	10

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)	STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
29	C10	1	C10	1	11(19/4)				C3-11	38	23	5	1	01
									C3-12	30	25	6	1	02
									C3-13	34	20	4	2	02
									C3-14	12	24	9	14	01
									C3-15	17	13	13	14	02
30	D1	54	D1	1	88(99/77)	21	M	77(87/67)	D1-1	72	41	9	1	01
			H10	1	92(98/86)				D1-2	72	29	14	8	02
									D1-3	66	36	15	6	03
									D1-4	79	31	7	5	04
									D1-5	56	29	28	9	05
									D1-6	102	14	6	0	06
									D1-7	91	24	3	4	07
									D1-10	92	23	3	3	08
									D1-19	34	38	14	20	07
31 (AV)	D2	48	D2	1	94(99/90)	22	F	93(98/89)	D1-9	104	14	3	0	01
									D1-17	76	16	13	2	02
									D1-18	60	10	6	1	03
									D1-20	38	46	10	9	02
									D1-21	18	29	17	7	00
									D2-10	32	16	8	2	00
									D2-11	26	15	14	18	00
									D3-13	63	25	1	3	00
32	D3	44	D3	3	61(78/44)				D1-11	50	57	13	1	01
									D1-12	96	22	1	3	02
									D1-13	30	22	16	8	03
									D1-14	34	20	9	7	04
									D1-15	26	43	23	27	05
									D1-16	42	34	22	12	06
									D3-17	15	13	1	1	00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)	STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
33 (AV)	D4	23	D4	1	62(82/43)				D1-22	51	33	19	1	01
			H11	1	90(94/85)				D1-23	33	21	21	28	02
									D1-24	57	39	4	2	03
									D2-2	96	12	5	1	01
									D2-3	77	24	7	6	04
									D2-7	60	36	10	.7	05
									D3-12	22	11	6	6	00
									D3-16	14	7	5	4	00
34 (AV)	D5	14	D5	1	77(90/64)	23	M	35(45/25)	D2-1	60	39	10	5	01
									D2-5	74	30	6	2	02
									D2-6	47	14	9	10	03
									D2-9	43	6	6	4	04
35 (AV)	D6	12	D6	3	71(84/58)				D2-4	35	65	7	7	01
36 (AV)	D7	16	D7	3	83(94/73)				D2-12	75	27	11	1	01
									D2-13	61	44	4	4	03
									D2-14	61	21	19	11	03
									D3-14	66	21	3	2	00
									D3-15	68	21	3	0	00

	PRETEST		POSTTEST			FINAL			STUDY GUIDE					
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
37	D8	21	D8	1	51(71/32)	24	F	22(24/20)	D2-15	40	44	14	14	01
			H12	1	27(41/13)				D2-16	78	20	5	3	02
									D2-17	72	31	2	0	03
									D2-18	55	32	11	5	04
									D2-19	34	45	21	3	05
									D2-20	46	37	16	2	06
									D2-21	27	8	5	4	06
									D2-22	28	7	6	1	06
									D2-23	18	16	5	3	06
									D2-24	33	5	4	0	07
									D3-1	27	19	15	6	07
									D3-2	39	11	0	5	07
									D3-3	28	8	8	1	07
									D3-4	18	8	6	16	06
									D3-18	23	6	2	4	00
									D3-19	11	10	8	0	00
									D3-20	14	6	1	1	00
38	D9	21	D9	1	75(88/62)	25	M	79(89/70)	D3-5	25	7	8	6	01
									D3-6	46	30	14	8	02
									D3-7	27	31	18	16	02
									D3-8	27	10	4	1	02
									D3-9	21	14	1	2	02
									D3-10	53	28	11	0	03
									D3-11	28	15	4	1	00
									D3-21	10	8	2	0	00
39	E1	0	E1	0	88(96/80)				E1-1	83	20	7	6	01
									E1-2	106	7	3	0	02
									E1-3	81	29	4	2	03
40	E2	6	E2	0	88(95/80)	26	M	82(88/76)	E1-4	45	40	18	13	01
									E1-5	90	16	6	4	02
									E1-6	38	27	19	32	03
									E1-8	82	18	6	7	04

	PRETEST		POSTTEST			FINAL			STUDY GUIDE					
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
41	E3	6	E3	3	54(79/29)	27	F	65(76/53)	E1-7	49	26	10	5	01
			H13	1	70(85/55)				E1-9	57	29	22	7	02
									E1-10	94	14	5	2	04
									E1-12	87	20	6	2	04
									G2-16	33	26	8	22	00
42	E4	3	E4	2	41(60/21)				E1-13	75	27	9	2	01
									E1-17	88	18	3	0	02
									E1-18	36	30	28	16	03
									E1-19	16	49	36	8	04
									E1-20	40	14	10	15	05
									E1-21	77	23	4	1	06
43	E5	14	E5	0	76(90/61)				E1-14	62	37	12	1	01
									E1-15	37	28	21	26	02
									E1-16	27	29	26	27	03
44	E6	5	E6	3	56(76/36)				E1-22	28	30	27	20	01
									E1-23	24	63	10	8	02
									E1-24	70	25	8	1	03
45	E7	2	E7	2	60(78/42)	28	M	76(87/66)	E2-1	46	47	11	2	01
									E2-2	45	47	11	2	02
									E3-9	17	22	24	12	03
									E3-10	9	7	4	2	04
									E3-11	9	10	1	3	05
									E3-13	7	7	5	1	00
									E3-14	44	16	5	5	00
46	E8	2	E8	1	40(64/16)				E2-3	61	27	13	2	01
									E2-5	42	34	21	5	02
									E2-6	52	32	9	5	03
									E2-7	47	25	16	9	04
									E2-8	19	16	14	10	05
									E3-5	19	10	3	2	00
									E3-15	7	14	3	0	00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
47	E9	3	E9	1	8(14/2)			
48	E10	0	E10	3	15(23/6)	29	F	47(61/33)
			H15	1	18(33/5)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
E2-9	30	31	27	6	00
E2-10	12	30	35	15	02
E2-11	19	13	5	11	03
E2-22	12	53	21	15	04
E2-23	17	23	21	20	05
E3-6	16	9	3	2	00
E2-12	30	31	22	8	01
E2-13	34	27	19	11	02
E2-14	56	25	6	3	03
E2-15	15	32	30	13	04
E2-16	25	5	7	8	05
E2-17	21	14	4	2	06
E2-18	40	19	18	9	07
E2-19	21	13	6	3	08
E2-20	33	28	20	5	07
E2-21	7	13	11	5	07
E2-24	17	8	3	3	07
E3-1	17	29	28	5	09
E3-2	31	14	17	16	09
E3-3	44	18	10	5	09
E3-4	49	24	2	2	09
E3-7	16	8	3	2	00
E3-8	40	17	12	6	00
E3-16	11	5	3	3	00
E3-17	13	4	2	3	00
E3-18	13	2	2	0	00
E3-19	6	3	4	1	00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
49	F1	0	F1	1	89(96/82)	30	F	78(85/70)
	F2	36	H16	1	82(94/70)			
50	F3	6	F3	0	96(98/94)			
51	F4	9	F4	3	83(94/71)	31	F	65(72/57)
52	F5	0	F2	1	95(100/91)	32	F	57(76/39)
			F5	1	57(85/30)			
			H17	1	82(93/71)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
F1-1	99	12	3	0	01
F1-2	55	39	17	3	02
F1-3	100	7	4	3	03
F1-4	87	20	4	3	04
F1-5	90	19	4	0	05
F1-6	87	19	4	3	06
F1-15	30	23	33	18	00
F1-16	58	34	10	8	06
F2-13	58	21	13	8	07
F2-15	50	28	12	6	07
G1-22	52	47	2	1	05
F1-7	96	12	3	2	01
F1-8	103	7	1	2	02
F1-9	96	8	4	5	03
F1-10	102	9	1	0	01
F1-11	82	24	3	3	00
G1-20	60	36	5	2	01
G1-23	93	7	1	1	00
F1-12	49	46	9	8	01
F1-13	60	32	11	9	02
F1-14	21	17	39	35	02
F2-11	52	27	11	11	03
G2-3	50	34	11	6	00
G2-15	37	25	16	11	00
G2-24	42	19	15	10	01
I2-8	58	13	8	8	00
I3-13	11	18	16	19	00
M2-22	13	12	3	7	00
P1-8					00
P1-9					00

	PRETEST		POSTTEST			FINAL		
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)
53	F6	3	F6	2	77(94/60)			
	F10	0	F10	2	14(25/2)			
			M18	1	40(63/18)			
54	F7	15	F7	1	90(97/83)			
	F9	5	F9	3	50(69/31)			
55	F8	9	F8	3	92(95/89)			

	STUDY GUIDE				
ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
F2-1	88	13	2	3	01
F2-2	66	24	9	7	02
F2-3	74	16	12	3	03
F2-4	47	44	14	0	03
F2-5	42	32	25	6	00
F2-6	50	39	14	2	04
F2-10	71	21	9	2	04
F2-12	26	29	29	16	03
F2-14	29	37	20	12	03
F2-16	46	28	15	6	03
F2-17	34	28	21	12	05
F2-18	45	36	10	3	05
F2-22	59	24	5	6	04
J2-9	25	24	13	7	00
F1-17	39	55	12	3	01
F1-18	62	38	8	1	02
F1-19	79	24	3	3	03
F1-20	94	13	0	2	01
F1-21	63	19	15	13	03
F1-22	92	16	0	1	02
F1-23	62	32	9	6	00
F1-24	95	8	4	3	03
P1-3					00
F2-7	77	21	3	1	01
F2-8	56	40	6	1	02
F2-9	97	4	2	0	02
F2-19	68	13	1	12	03
F2-20	31	51	7	4	02
F2-21	27	32	23	12	02
F2-23	28	50	10	6	02
F2-24	61	24	6	2	04

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
56	G1	12	G1	0	79(94/64)			
57	G2	6	G2	1	67(91/43)			
58	G3	3	G3	1	51(67/34)			
	G9	1	G9	2	32(47/16)			
59	G4	3	G4	1	49(70/28)			
60	G5	11	G5	1	66(87/44)	33	M	76(86/65)
			H19	1	75(90/60)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
G1-1	65	30	10	3	01
G1-3	82	14	7	6	02
G1-10	101	5	3	1	03
G1-11	35	53	19	3	01
G1-12	52	36	16	5	04
P1-4					00
G1-5	62	44	3	0	01
G1-6	41	26	28	13	02
G1-2	74	31	3	1	01
G1-4	90	10	8	1	02
G1-7	83	17	6	3	03
G1-8	82	19	5	3	04
G1-9	96	11	2	0	06
G1-13	42	41	16	11	05
G1-14	40	39	16	13	07
G1-17	36	30	14	26	08
G1-24	59	32	5	6	09
P1-5					00
P1-6					00
P1-7					00
G1-15	66	25	12	4	01
G1-16	75	19	8	4	02
G1-18	18	36	46	6	03
G1-19	75	22	6	3	04
G2-2	41	44	17	2	00
G2-7	48	29	17	7	01
G2-21	42	22	15	6	02

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
61 (AV)	G6	4	G6	0	67(75/49)			
			G10	2	21(34/7)			
62	G7	2	G7	1	72(96/48)	34	M	48(64/31)
			H20	1	24(35/12)			
63	G8	0	G8	2	59(78/22)			
64 (AV)	I1	12	I1	0	100(100/100)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
G2-4	62	30	7	3	01
G2-10	49	44	5	0	01
G2-11	50	15	17	14	02
G2-12	43	40	12	2	03
G2-13	66	20	4	3	03
G2-14	53	19	9	12	01
G2-18	27	16	24	23	02
G2-19	22	26	20	17	00
G2-1	19	19	4	3	01
G2-5	56	25	11	6	02
G2-8	39	36	16	6	03
G2-9	75	3	8	8	03
G2-22	69	4	11	3	04
G2-23	41	28	11	6	02
J2-3	47	7	9	6	02
J2-4	38	22	6	3	02
G2-6	35	33	17	15	00
G2-17	34	37	12	5	01
G2-20	36	20	17	10	02
I1-1	93	6	3	1	01
I1-2	96	5	1	1	02
I1-3	93	5	4	1	02
I1-6	98	3	0	1	03
I1-12	61	28	8	5	04
I1-24	2	2	0	1	05

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
65	I2	0	I2	1	75(89/60)	35	M	69(85/54)
	I10	0	I10	0	79(96/62)			
(AV)								
66	I3	1	I3	0	98(100/97)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
I1-4	87	16	0	0	01
I1-5	86	13	4	0	02
I1-7	94	7	2	0	03
I1-8	41	17	22	23	04
I1-10	84	7	8	4	02
I1-11	41	51	8	3	00
I1-13	38	52	11	2	05
I1-14	91	9	2	1	00
I1-15	60	28	14	1	06
I1-16	97	6	0	0	07
I1-19	94	8	1	0	05
I1-22	2	1	0	0	08
I1-23	19	3	0	0	05
P1-10					00
P2-48					00
I1-9	86	14	1	1	01

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
67	I4	1	I4	2	74(89/58)			
	I5	2	I5	0	87(98/75)			
	I9	3	I9	0	95(100/90)			
(AV)								

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
I1-17	44	25	21	13	01
I1-18	69	20	12	2	02
I1-20	85	16	1	1	03
I1-21	51	37	11	3	04
I2-1	40	35	10	4	05
I2-2	60	16	4	.6	04
I2-3	62	18	5	1	06
I2-4	74	11	1	1	07
I2-5	65	18	5	0	04
I2-10	52	33	2	0	08
I2-11	58	20	6	3	04
I2-12	34	31	20	4	00
I2-13	53	9	11	14	09
I2-22	53	22	8	4	03
I3-2	47	11	2	2	00
I3-4	41	11	5	6	00
I3-5	22	18	14	7	00
I3-8	53	8	2	8	07
I3-19	35	15	6	7	06
P1-11					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
68 (AV)	I6	0	I6	2	66(91/40)	36	M	54(71/37)
69	I7	0	I7	1	79(94/63)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
I2-6	71	13	3	2	01
I2-7	71	7	8	1	02
I2-9	38	31	17	3	00
I2-14	52	25	6	6	03
I2-15	8	5	1	0	04
I2-21	35	37	7	9	05
I2-23	31	39	13	3	06
I2-24	50	27	5	4	07
I3-1	58	4	1	0	08
I3-3	59	3	0	1	09
I3-7	44	15	1	2	00
I3-20	37	8	6	10	00
I3-21	23	16	12	11	00
P1-12					00
P1-13					00
P1-14					00
I2-16	71	14	2	0	01
I2-17	52	27	5	2	02
I2-18	44	30	7	6	03
I2-19	31	38	13	5	04
I2-20	22	49	8	8	04
I3-6	57	5	1	0	05
I3-15	40	15	2	7	06
I3-16	26	19	16	2	06
I3-18	21	21	14	6	07
P1-15					
P1-16					

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
70	I8	2	I8	0	80(95/64)			
71	J1	15	J1	0	38(57/19)	37	M	60(66/63)
72	J2	6	J2	1	92(99/86)	38	F	64(76/52)
73	J3	1	J3	3	58(80/36)	39	M	51(64/39)

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
I3-9	21	19	15	7	01
I3-10	27	28	5	3	02
I3-11	45	16	1	2	03
I3-12	23	20	10	9	04
I3-14	46	11	3	3	05
I3-17	37	17	7	3	03
I3-22	35	15	7	5	01
I3-23	38	20	1	1	03
I3-24	30	16	6	6	03
J1-1	79	17	3	1	01
J1-2	87	7	1	4	01
J1-3	82	14	4	0	03
J1-4	85	13	0	0	04
J1-5	71	23	4	1	04
M2-11	20	9	5	13	00
J1-6	66	29	4	1	01
J1-7	94	4	1	0	02
J1-8	76	17	6	1	03
J1-9	77	15	5	3	01
J1-10	77	13	8	2	04
P1-1					00
J1-11	57	26	11	6	01
J1-12	68	25	5	2	01
J1-21	28	15	5	1	02
J1-24	29	7	2	2	04
J2-5	56	9	4	0	00
J2-6	38	16	11	4	05
J2-7	34	22	7	6	06
J2-8	28	32	6	3	01
P1-2					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
74	J4	4	J4	3	51(70/32)	40	F	38(52/24)
	J10	2	J10	1	5(11/0)			
75	J5	3	J5	1	74(91/56)	41	F	47(58/35)
76	J6	3	J6	1	73(91/54)			
77 (AV)	J7	2	J7	1	75(89/61)			
78 (AV)	J8	1	J8	1	81(94/67)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
J1-13	70	24	1	5	01
J1-14	41	35	11	13	02
J1-15	69	27	2	2	03
J1-17	67	22	7	4	04
P1-18	47	28	19	4	00
P1-23					00
J1-16	63	30	5	2	01
J1-18	47	28	19	4	02
J1-19	50	23	14	11	03
J1-20	21	13	15	13	03
J1-22	13	11	6	14	03
J1-23	13	10	6	9	02
P1-17					00
P1-19					00
P1-20					00
J2-1	40	20	7	2	02
J2-2	23	14	10	22	01
P1-21					00
P1-22					00
J2-10	56	9	2	2	01
J2-11	55	8	3	3	02
J2-12	58	9	1	1	03
P1-24					00
J2-13	41	21	7	0	01
J2-14	54	9	2	4	02
J2-15	55	10	2	2	03
J2-16	33	19	14	3	04
J2-17	23	25	10	11	04

	PRETEST		POSTTEST			FINAL			STUDY GUIDE					
T.O.	ITEM	C(U/L)	ITEM	L.C.	C(U/L)	ITEM	M/F	C(U/L)	ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
79	J9	1	J9	1	62(87/37)				J2-18	12	9	2	13	01
									J2-19	20	11	3	0	01
									J2-20	11	10	4	8	01
									J2-21	21	8	1	2	01
									J2-22	16	14	3	1	02
									J2-23	13	8	3	5	03
									J2-24	12	13	3	1	03
									P2-28					00
80	K1	4	K6	1					K1-1	75	24	9	0	01
	K2	13	K8	1					K1-2	58	46	3	1	02
			*K3	1					K1-3	100	4	0	3	03
			*K8	1					K1-4	53	23	23	8	04
									K1-5	69	23	13	2	05
									P2-25					00
81	K3	2	K2	1					K1-6	93	9	2	2	01
			*K1	1					K1-7	81	19	3	3	02
									K1-8	72	25	8	1	03
									K1-9	31	49	17	9	04
									K1-10	99	6	1	0	05
									K1-11	88	9	1	8	06
									P2-26					00
									P2-31					00
82	K4	3	K1	2		42	F	27(39/15)	K1-12	43	23	21	19	01
	K5	3	K10	2					K1-13	73	32	1	0	02
			*K6	2					K1-14	27	59	12	8	03
			*K9	2					K1-15	43	26	17	28	04
									K1-16	71	25	8	0	05
									K1-17	22	39	27	14	06
									K2-20	17	15	15	8	00
									K2-21	22	8	10	7	00
									P2-29					00
									P2-30					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
83 (AV)	K6	3	K3	1				
			*K5	1				
84	K7	28	K9	0		43	F	33(47/18)
			*K2	0				
85	K8	9	K7	1		44	F	72(85/60)
			*K4	1				

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
K1-18	43	32	26	4	01
K1-19	48	43	11	1	02
K1-20	61	27	14	1	03
K1-21	91	8	4	0	04
K1-22	81	14	3	2	05
K1-23	36	44	17	3	06
K1-24	49	37	10	4	07
K2-22	12	17	9	5	00
P2-27					00
P2-32					00
K2-1	76	15	3	2	01
K2-2	43	28	16	9	02
K2-3	47	37	5	7	03
K2-4	63	22	7	4	03
K2-5	64	19	7	5	04
K2-6	83	11	1	0	05
K2-7	57	24	5	9	06
K2-8	74	4	5	10	07
K2-9	37	35	14	0	08
K2-10	56	21	8	8	09
K2-11	40	37	14	0	10
K2-23	25	12	3	3	11
P2-33					00
K2-12	74	9	4	2	01
K2-13	76	7	3	1	02
K2-14	74	9	3	1	03
K2-15	15	26	21	25	00
K2-24	16	9	4	4	02
M3-13	13	6	1	2	00
M3-18	3	6	2	2	00
P2-34					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
86	K9	10	K4	1		45	F	89(94/84)
	K10	10	K5	0				
			*K7	1				
			*K10	0				
87	L1	55	L1	0				
			*L10	0				
88	L2	6	L2	1		47	F	45(59/31)
			*L1	1				
89	L3	21	L3	2		46	M	63(78/48)
			*L9	2				

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
K2-16	65	12	3	7	01
K2-17	51	22	10	4	02
K2-18	43	25	12	7	03
K2-19	49	24	7	6	04
P2-35					00
L1-1	79	13	3	1	01
L1-2	90	5	0	1	02
L1-3	85	4	5	2	03
L1-4	78	11	3	4	04
L1-5	60	20	11	5	05
P2-36					00
L1-7	39	36	11	10	01
L1-8	36	26	18	15	02
L1-9	50	28	16	2	03
L1-10	63	15	14	2	04
L1-14	48	28	12	2	03
L2-10	56	14	7	0	03
L3-23	8	2	2	1	00
P2-37					00
L1-11	52	34	6	2	01
L1-12	33	40	12	9	02
L1-13	34	37	11	11	03
L1-22	50	26	8	2	03
L3-24	6	2	1	2	00
P2-38					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
90	L4	29	L4	2		48	F	80(90/71)
			*L2	2				
91	L5	17	L5	2		49	M	57(71/43)
			*L8	2				

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
L1-15	67	13	5	3	01
L1-16	32	12	27	19	02
L1-17	75	8	3	2	03
L1-18	65	17	6	1	04
L1-19	76	11	0	1	05
L1-20	59	20	6	3	06
L1-21	41	22	15	9	06
L1-23	65	15	5	1	07
L1-24	70	12	2	2	06
P2-39					00
L2-1	44	15	14	8	01
L2-2	49	13	10	8	02
L2-3	48	22	7	4	03
L2-4	49	12	10	9	04
L2-5	70	8	1	1	05
L2-6	37	26	8	8	06
L2-7	52	20	4	2	07
L2-8	40	30	4	3	08
L2-9	47	20	6	5	09
L2-11	56	17	2	0	03
L2-12	57	14	1	4	03
L2-13	32	23	6	15	06
L2-14	42	23	8	3	09
L3-7	16	12	10	8	00
L3-15	16	5	10	4	00
L3-21	7	1	5	1	00
P2-40					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
92 (AV)	L6	26	L6 *L3	3 3		50	F	60(72/48)
93	L7	3	L7	2		51	F	12(17/7)
94	L8	35	L8 *L4	0 0				
95	L9	19	L9 *L6	0 0				

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
L2-15	30	15	18	9	01
L2-16	49	15	2	7	02
L2-17	63	5	1	2	03
L2-19	33	18	9	6	04
L2-20	44	10	7	3	04
L3-16	18	3	1	-0	00
L3-17	13	4	2	2	03
L2-18	40	25	3	3	01
L2-21	35	14	10	4	02
L2-22	39	14	8	2	02
L2-23	45	11	3	3	02
L2-24	24	13	6	2	02
L3-4	25	10	8	5	00
L3-18	17	2	2	0	00
L3-19	8	8	1	2	00
L3-20	10	5	1	0	00
P2-41					00
P2-43					00
P2-44					00
P2-47					00
L3-1	45	5	0	0	01
L3-2	19	17	12	2	02
L3-3	18	16	9	7	02
L3-5	14	16	15	2	03
L3-9	25	7	2	8	00
P2-42					00
L3-6	19	17	7	4	01
L3-8	21	18	4	2	00
L3-10	16	7	11	9	02
L3-11	24	2	5	8	00
P2-45					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
96	L10	5	L10	2				
			*L5	2				
97 (AV)	M1	36	M1	0	41(61/21)			
98	M2	23	M2	0	45(60/30)			
99	M3	3	M3	0	72(82/62)			
100 (AV)	M4	5	M4	0	65(80/50)	52	M	43(49/37)

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
L3-12	22	10	4	2	01
L3-13	18	9	6	3	02
L3-14	16	10	6	1	02
P2-46					00
M1-4	41	26	9	9	01
M2-10	18	20	5	4	01
M1-1	57	16	4	9	01
M1-2	32	47	5	2	02
M1-3	37	28	15	6	02
M3-9	10	11	5	1	00
N1-11	19	16	12	12	00
N2-21	16	10	4	5	02
P3-49					00
M1-5	33	39	6	4	01
M1-6	27	42	8	4	02
M1-7	38	21	13	6	02
M2-1	32	13	5	1	03
M2-6	23	23	2	2	03
M2-15	11	11	10	4	02
M2-16	14	7	0	8	02
M2-23	11	12	6	6	02
M3-17	7	5	0	2	02
P3-50					00
P3-51					00
P3-54					00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
101	M6	10	M5	1	45(58/31)			
102	M6	1	M6	1	41(58/24)			
103	M7 M9	2 0	M9	1	31(46/16)			
104	M8	15	M8	0	86(95/76)			

ITEM	STUDY GUIDE ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
M3-1	14	13	5	1	01
M3-2	13	9	10	1	02
M3-3	14	7	7	4	03
M3-4	18	8	3	3	04
M3-5	16	10	4	2	05
M3-6	10	11	7	4	06
P3-69					00
M1-8	64	7	3	4	01
M1-9	51	20	5	3	02
M1-10	24	24	25	6	03
M1-11	32	29	13	2	00
M1-13	29	33	10	1	04
M1-14	37	23	6	6	05
M1-15	32	19	14	7	06
M3-7	7	12	6	6	00
M3-8	15	10	2	3	00
M3-14	8	6	3	4	00
N1-12	15	18	13	10	00
N1-13	19	17	9	8	00
N1-17	19	27	2	1	00
P3-52					00
P3-53					00
P3-55					00
M1-16	31	19	8	11	01
P3-56					00
M1-17	31	23	14	1	01

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
105			M7	0	60(77/43)			
106	M10	1	M10	1	57(65/50)	53	M	60(68/52)
107	N1	27	N1	0	69(86/51)	54	M	71(82/60)

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
M1-18	34	16	12	6	01
M1-19	27	20	8	9	02
M1-20	24	16	16	7	03
M1-21	35	14	12	3	04
M1-22	27	26	7	4	00
M1-23	26	25	8	.5	00
M1-24	22	13	11	17	05
N1-14	29	15	6	2	02
N1-15	29	7	6	9	03
M2-2	18	18	11	4	01
M2-3	24	16	6	4	02
M2-4	14	11	13	11	03
M2-5	23	12	11	4	04
M2-7	20	12	8	8	02
M2-8	18	12	12	5	03
M2-9	23	15	6	3	02
M2-12	22	12	7	2	03
M2-18	21	11	5	2	02
M2-19	12	10	9	6	02
M3-10	7	5	10	3	03
P3-67					00
P3-68					00
N1-1	63	5	1	0	01
N1-2	58	8	3	0	02

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
108 (AV)	N2	1	N2	2	30(47/13)	56	M	46(56/35)
109 (AV)	N3	1	N3	2	29(30/9)			
110 (AV)	N4	1	N4	2	73(93/53)			
111 (AV)	N5	7	N5	2	82(92/72)	55	M	65(76/53)

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
N1-3	16	24	21	7	01
N1-4	50	12	5	0	02
N1-5	32	22	7	6	03
N1-6	23	11	6	26	04
N1-7	44	10	6	3	00
N1-9	43	13	4	2	01
N1-18	15	29	4	2	00
N3-10	2	2	4	1	00
N3-11	2	2	3	2	00
P3-62					00
N1-8	21	20	13	9	01
N1-10	28	16	11	6	02
N3-6	4	2	2	1	00
N3-7	5	3	1	0	00
N3-8	4	3	1	1	03
N3-9	3	2	1	3	03
N1-16	24	18	2	5	01
N1-19	25	19	6	1	02
N1-20	27	13	8	2	03
N1-21	12	19	0	18	00
N1-22	28	17	1	2	04
N1-23	28	14	6	0	00
N1-24	31	12	2	2	00
N3-3	6	3	2	0	00
P3-66					00
P3-67					00
N3-1	6	6	7	2	01
N3-2	9	7	2	2	02

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
112	N6	1	N6	1	55(81/29)			
113	N7	1	N7	2	20(34/5)			
114	N8	1	N8	2	40(63/18)	57	F	34(44/24)
115	N9	11	N9	0	19(27/12)	58	M	32(47/16)

STUDY GUIDE

ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
N2-1	14	16	10	8	01
N2-2	15	16	8	9	02
N2-3	24	17	4	2	03
N3-12	5	3	0	1	00
P3-65					00
N2-4	28	14	1	2	01
N2-5	14	14	7	8	02
N2-6	19	13	10	0	03
N2-7	23	6	4	7	03
N3-14	5	3	1	0	00
N3-16	2	4	2	0	00
N3-17	2	1	3	2	00
O3-22	14	4	1	2	02
N2-8	34	3	1	3	01
N2-9	24	10	4	2	02
N2-10	16	17	4	1	00
N2-12	19	11	6	2	03
N2-14	27	11	0	0	00
N2-16	20	15	1	2	04
N2-17	21	11	5	1	05
N2-18	8	19	7	3	00
N2-19	17	15	4	1	06
N3-5	4	3	2	0	00
O1-1	34	21	5	8	07
O1-2	58	3	3	4	08
O1-3	32	21	8	7	09
N2-11	20	13	4	2	01
N2-13	22	12	3	1	02
N2-15	22	7	7	2	02
N2-20	19	11	4	3	02
N3-4	2	4	1	3	00

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
116	N10	2	N10	2	44(55/32)	59	M	59(62/56)
117	07	1	01	1	89(97/81)			
118	08	0	02	1	67(91/44)			
119	09	1	03	1	39(61/18)			
120	010	1	04	2	68(91/46)			

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
N2-22	12	12	8	3	01
N2-23	13	16	3	3	02
N2-24	24	7	1	2	03
N3-15	3	3	3	0	00
01-4	49	17	1	1	01
01-5	51	11	2	4	02
01-6	26	30	10	2	03
01-7	53	9	4	2	04
01-8	54	5	4	4	05
01-9	33	21	6	7	06
03-18	12	2	5	3	07
01-11	47	15	2	2	02
01-10	32	20	11	3	01
01-13	34	19	5	8	01
01-14	50	11	3	2	02
01-15	35	14	9	8	03
01-16	29	20	11	5	01
01-17	40	20	3	2	02
01-18	36	19	7	2	03
01-19	32	12	14	5	04
01-20	28	18	12	4	05
01-21	20	13	18	11	01
01-22	23	17	8	13	05
01-23	34	15	6	6	01
01-24	35	6	8	11	01
03-19	11	7	4	0	03
03-23	10	4	4	4	05
03-24	8	6	4	4	05

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
121	06	2	05	1	49(79/19)			
122	05	0	06	1	40(54/26)			
123	04	0	07	1	73(89/57)	60	F	52(66/39)

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
02-1	43	9	3	2	01
02-2	23	7	12	15	02
02-3	19	15	15	8	03
02-4	25	20	8	4	04
02-5	31	13	7	6	05
02-6	40	11	4	2	06
02-7	45	7	4	1	07
02-8	38	11	4	4	08
02-9	34	10	6	7	09
02-14	21	19	7	6	10
02-15	21	13	9	9	10
02-21	23	9	10	5	06
02-22	18	23	2	4	06
02-23	23	11	5	7	06
02-24	27	9	5	4	10
02-10	37	10	6	4	01
02-11	31	16	5	3	02
02-12	34	8	8	5	03
02-13	17	14	12	10	03
02-16	21	21	8	1	01
02-17	40	7	3	1	02
02-18	24	12	6	9	03
02-19	25	12	7	7	04
02-20	28	12	2	6	05

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
124	03	0	08	1	30(46/14)			
125	02	0	09	1	45(64/26)			
126	01	1	010	1	39(55/24)			
151								
152								
153								

STUDY GUIDE ITEM	ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
03-1	20	7	0	1	01
03-2	12	14	1	1	02
03-3	14	9	2	2	03
03-4	10	14	3	1	04
03-5	15	8	4	1	05
03-8	11	7	5	3	06
03-9	13	5	1	6	07
03-10	13	6	3	3	08
03-11	11	8	3	2	10
03-14	12	7	3	2	09
03-15	10	5	6	3	10
03-20	7	9	3	3	11
03-21	8	5	5	4	12
03-6	7	13	5	3	01
03-7	15	3	7	2	02
03-12	12	9	2	1	01
03-13	17	6	0	1	02
03-16	11	7	3	2	03
03-17	13	3	3	3	03
A3-21	13	1	2	1	01
A3-22	10	5	0	0	02
A3-23	8	4	2	1	03
A3-24	9	5	1	0	04
C3-22	1	6	1	1	01
C3-23	2	3	1	1	02
C3-24	1	2	2	2	03
D3-22	3	3	0	0	01
D3-23	3	3	0	0	02
D3-24	4	1	1	0	03

T.O.	PRETEST ITEM	PRETEST C(U/L)	POSTTEST ITEM	POSTTEST L.C.	POSTTEST C(U/L)	FINAL ITEM	FINAL M/F	FINAL C(U/L)
154								
155								
156								
157								
158								

ITEM	STUDY GUIDE ONE PUNCH	TWO PUNCH	THREE PUNCH	FOUR PUNCH	E.O.
E3-20	4	4	0	1	01
E3-21	1	3	3	2	02
E3-22	6	4	0	0	03
E3-23	4	5	1	0	04
E3-24	6	3	0	1	05
M3-19	6	3	2	2	01
M3-20	6	5	2	0	02
M3-21	6	6	0	1	03
M3-22	5	7	1	0	04
M3-23	6	5	1	1	04
M3-24	8	1	3	1	05
N3-22	4	2	0	1	01
N3-23	4	2	0	1	02
N3-24	4	0	2	1	03
N3-13	2	4	3	0	01
N3-18	3	0	4	1	02
N3-19	3	3	2	0	03
N3-20	3	3	2	0	03
N3-21	3	4	0	1	04
01-12	17	20	8	9	01